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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO INTERFERENCE MEASURING SET AN/URM-7

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HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1958

TECHNICAL MANUAL
No. 11-5544-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *8 May 1958*

RADIO INTERFERENCE MEASURING SET AN/URM-7

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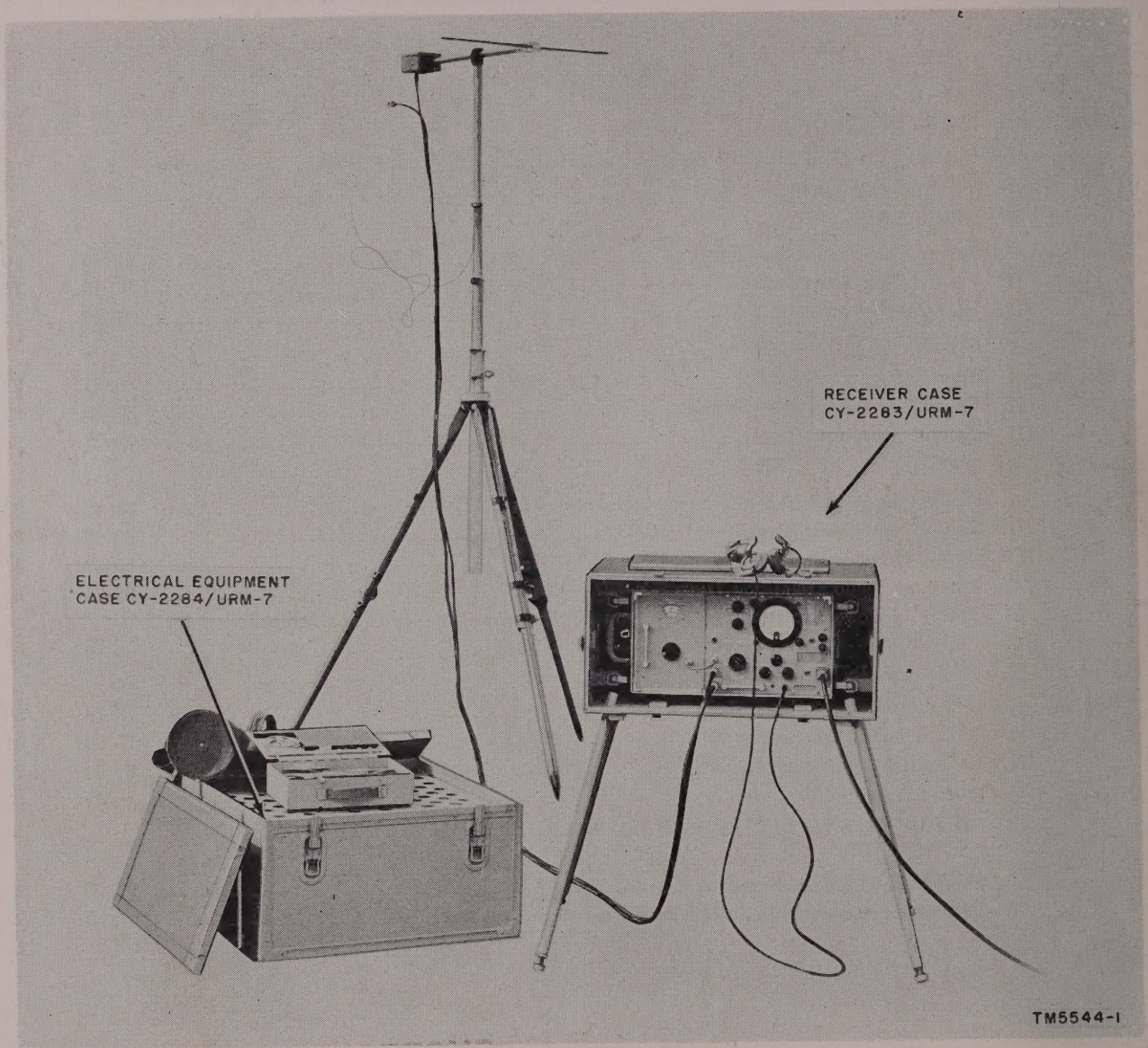


Figure 1. Radio Interference Measuring Set AN/URM–7, major components.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual covers the installation, operation, maintenance, and repair of Radio Interference Measuring Set AN/URM–7 (fig. 1).

b. Forward comments on this publication directly to Commanding Officer, U. S. Army Signal Publications Agency, Fort Monmouth, N. J.

2. Forms and Records

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report), to Commanding Officer, U. S. Army Signal Equipment Support Agency, Fort Monmouth, New Jersey, as prescribed in AR 700–38.

b. Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment), as prescribed in AR 700–58.

c. Preventive Maintenance Form. Prepare DA Form 11–266 (Maintenance Check List for Signal Equipment (Test Equipment)) in accordance with instructions on the form (fig. 12).

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Radio Interference Measuring Set AN/URM–7 (fig. 1) is a test instrument for accurate evaluation of broad and narrow band radio frequency (RF) interference and for the measurement of continuous-wave (cw) field intensity. It is a laboratory-type instrument used in—

(1) Engineering evaluation of electronic systems interference.
(2) Measurement of absolute field strength.
(3) Site surveys.
(4) Production-line quality control.
(5) Signal-depot maintenance.
(6) Development programs of research and development laboratories.

b. The AN/URM–7 may also be used to determine the effectiveness of RF interference suppression systems used on gasoline engines, engine-driven generators, and miscellaneous engine-driven electrical machinery. It can be used to measure RF interference voltages present across cable terminals with the accessory units that are provided. The frequency range is from 20 to 400 megacycles (mc).

c. The equipment may be operated from either a 24-volt direct-current (dc) source capable of supplying 10 amperes of current or from an alternating-current (ac) source of 115 or 230 volts, 50 to 400 cycles.

4. Technical Characteristics

a. Radio Frequency Tuner TN–326/URM–7.

Frequency range:	
Band 1	20 mc to 70 mc.
Band 2	70 mc to 220 mc.
Receiver type	Superheterodyne.
Types of signals received	Cw and amplitude-modulated by voice or pulses.
Intermediate frequency	10.7 mc.
Number of tubes	12.
Power requirements	150 volts dc, 80 ma.
	6.3 volts ac, 50 to 400 cps, 2 amp.

b. Radio Frequency Tuner TN–327/URM–7.

Frequency range	200 mc to 400 mc.
Receiver type	Superheterodyne.
Types of signals received	Cw and amplitude-modulated by voice or pulses.
Intermediate frequency	42 mc.
Number of tubes	9.
Power requirements	150 volts dc, 80 ma.
	6.3 volts ac, 50 to 400 cps, 1.5 amp.

c. Radio Receiver R–854/URM–7.

RF noise generator—Impulse type.
Noise generator repetition rate—70 cps.
Noise generator useful frequency spectrum—150 kc to 1,000 mc.
Power input—24 volts dc, 10 amperes or 115 or 230 volts ac, 50 to 400 cycles, 120 watts.
Power supply output—+150 volts dc, .1 amp.
—150 volts dc, .01 amp.
±300 volts dc, 12 ma.
6.3 volts ac, 4.75 amp, heater.
6.3 volts dc, 80 ma, relay.
1.25 volts dc, 9.8 ma, heater.
Signal attenuator—80-db attenuation in 20-db steps.
Impulse generator output—81 db above 1 μv/mc.

d. Power Isolation and Step-Down Transformer TF–248/G.

Input voltage—115 or 230 volts ac.
Input frequency—50 to 400 cps.
Output voltage—115 volts ac, 50 to 400 cps.

e. Motor-Generator PU–388/G.

Power input—23 to 29 volts dc, 10 amp.
Power output—117 volts ac, 60 cps, 120 watts.

5. Components of Radio Interference Measuring Set AN/URM–7

a. Components (figs. 1–3).

Component	Quantity	Height (in.)	Depth (in.)	Width (in.)	Weight (lb)
Radio Receiver R–854/URM–7	1	10 1/8	15 1/8	19 1/8	50.5
Radio Frequency Tuner TN–326/URM–7	1	8 5/8	12 5/8	6 1/4	14
Radio Frequency Tuner TN–327/URM–7	1	8 5/8	12 5/8	6 1/4	13.5
Antenna AS–920/URM–7	1			24	2.3
Antenna AS–921/URM–7	1			24	1.8
Antenna AS–922/URM–7	1	24	9	24	7
Antenna Coupler CU–633/URM–7	1	1 1/4	3 5/8	3 1/8	.75
Antenna Tripod MT–1947/URM–7	1	44 1/2			16
Audio Level Meter ME–133/U	1	4 1/4	4 5/8	4 1/4	1.6
Cord CD–307–A (30′0″)	1	360 (lg)			1.25
Cord CD–307–A (5′5″)	2	65 (lg)			.3
Cotton Duck Bag CW–452/URM–7	1	44	7	7	3.2
Electrical Field Interference Measuring Probe MX–2303/URM–7	1	1	3 1/2	1 1/2	.3
Electrical Field Interference Measuring Probe MX–2304/URM–7	1	1	2 3/4	1 1/2	.25
Electrical Field Interference Measuring Probe MX–2306/URM–7	1	8	1	1	.3
Electrical Cord Assembly CX–4305/U (30′0″)	1	360 (lg)			1.25
Electrical Power Cable Assembly CX–4307/U (8′0″)	1	96 (lg)			.75
Electrical Special Purpose Cable Assembly CX–4306/U (3′9″)	1	45 (lg)			1.2
Electrical Equipment Case CY–2284/URM–7	1	14	26 5/8	26 7/16	68
Fixed Attenuator CN–462/URM–7	1	3 5/8	49/64	49/64	.25
Ground Rod GP–117/URM–7	1	12		3	.3
Magnetic Field Interference Measuring Probe MX–2305/URM–7	1	9 1/2	1	3 3/8	1
Radio Frequency Cable Assembly CG–546A/U (0′6″)	1	6 (lg)			.2
Radio Frequency Cable Assembly CG–546A/U (2′6″)	1	30 (lg)			.3
Receiver Case CY–2283/URM–7	1	14 5/8	18 3/8	29 1/8	4
Tuner Case CY–2282/URM–7	1	12	17	12	2
Mast Section AB–21/GR	14				.2
Headset HS–33–A	2				.6
RF Antenna Cable	1	360 (lg)			5.4
Motor-Generator PU–388/G	1	5	8 19/64	4 1/2	27.5
Power Isolation and Step-Down Transformer TF–248/G	1	6 7/16	7 5/8	4 5/8	10
Steel Megacycle Tape	1	1/2	3	3	.3

b. Running Spares.

Quantity	Item
2	Brush sets.
1	Electrometer detector unit.
6	Fuses, 2 amperes, 125v, slow blow, 1¼ inches long, ¼-inch diameter.
6	Fuses, 5 amperes, 125v, slow blow, 1¼ inches long, ¼-inch diameter.
6	Fuses, 15 amperes, 32v, 1¼ inches long, ¼-inch diameter.
2	Lamps, 6 to 8 volts, miniature bayonet base.
2	Mast Sections AB–21/GR.
1	Vibrating regulator.
2	Electron tubes QA2.
2	Electron tubes 6AK5W.
1	Electron tube 6AL5.
1	Electron tube 6AH6.
3	Electron tubes 6BJ6.
1	Electron tube 6BQ7.
1	Electron tube 6CB6.
1	Electron tube 6F4.
1	Electron tube 6U8.
2	Electron tubes 6X4W.
1	Electron tube 12AT7WA.
1	Electron tube 12AU7.
1	Electron tube 5814A.
1	Electron tube 5876.

6. Common Names

Nomenclature	Common name
Radio Interference Measuring Set AN/URM–7.	Test set.
Radio Receiver R–854/URM–7	Main unit.
Radio Frequency Tuner TN–326/URM–7.	Lf tuner.
Radio Frequency Tuner TN–327/URM–7.	Hf tuner.
Antenna AS–920/URM–7	Lf antenna.
Antenna AS–921/URM–7	Hf antenna.
Antenna AS–922/URM–7	Discone antenna.
Electrical Power Cable Assembly CX–4307/U (8′0″).	Ac power cable.
Electrical Special Purpose Cable Assembly CX–4306/U (3′6″).	Alinement harness.
Cotton Duck Bag CW–452/URM–7	Tripod bag.
Electrical Cord Assembly CX–4305/U (30′0″).	Remote meter cord.
Cord CD–307–A (30′0″)	Headset cord.
Radio Frequency Cable Assembly CG–546A/U (0′6″).	Six-inch RF cable.
Antenna Coupler CU–633/URM–7	Unbalanced injection block.
Electrical Field Interference Measuring Probe MX–2303/URM–7.	500-ohm coupler.
Electrical Field Interference Measuring Probe MX–2304/URM–7.	50-ohm coupler.
Steel megacycle tape	Tape.
Electrical Field Interference Measuring Probe MX–2306/URM–7.	Electrical field probe.
Fixed Attenuator CN–462/URM–7	External pad.
Magnetic Field Interference Measuring Probe MX–2305/URM–7.	Magnetic field probe.
Audio Level Meter ME–133/U	External meter.
Electrical Equipment Case CY–2284/URM–7.	Transit case.
Receiver Case CY–2283/URM–7	Transit case.
Tuner Case CY–2282/URM–7	Transit case.
Antenna Tripod MT–1947/URM–7	Tripod.
Power Isolation and Step-Down Transformer TF–248/G.	Transformer.
Motor-Generator PU–388/G	Motor-generator.

7. Radio Receiver R–854/URM– 7

a. The main unit is a panel-chassis assembly (fig. 2) contained in an aluminum case. The case is equipped with two carrying handles and a detachable cover that protects the operating controls on the front panel.

b. The front panel contains all the controls and jacks for the operation of the equipment. There is also an opening where one of two plug-in tuners is inserted.

c. Power is applied to the main unit through a connector at the lower right side of the front panel.

8. RF Tuner–326/URM–7

a. The low-frequency (lf) tuner is a panel-chassis assembly (fig. 2) which can be plugged into the main unit or placed in a transit case.

b. All connections to the main unit except two on the front panel are made through a connector on the rear of the unit which plugs into the main unit.

9. RF Tuner TN–327/URM–7

a. The high-frequency (hf) tuner is a panel-chassis assembly (fig. 2) that can be plugged into the main unit or placed in the transit case (par. 8*a*).

b. All connections to the main unit except one on the front panel are made through a connector on the rear of the unit which plugs into the main unit.

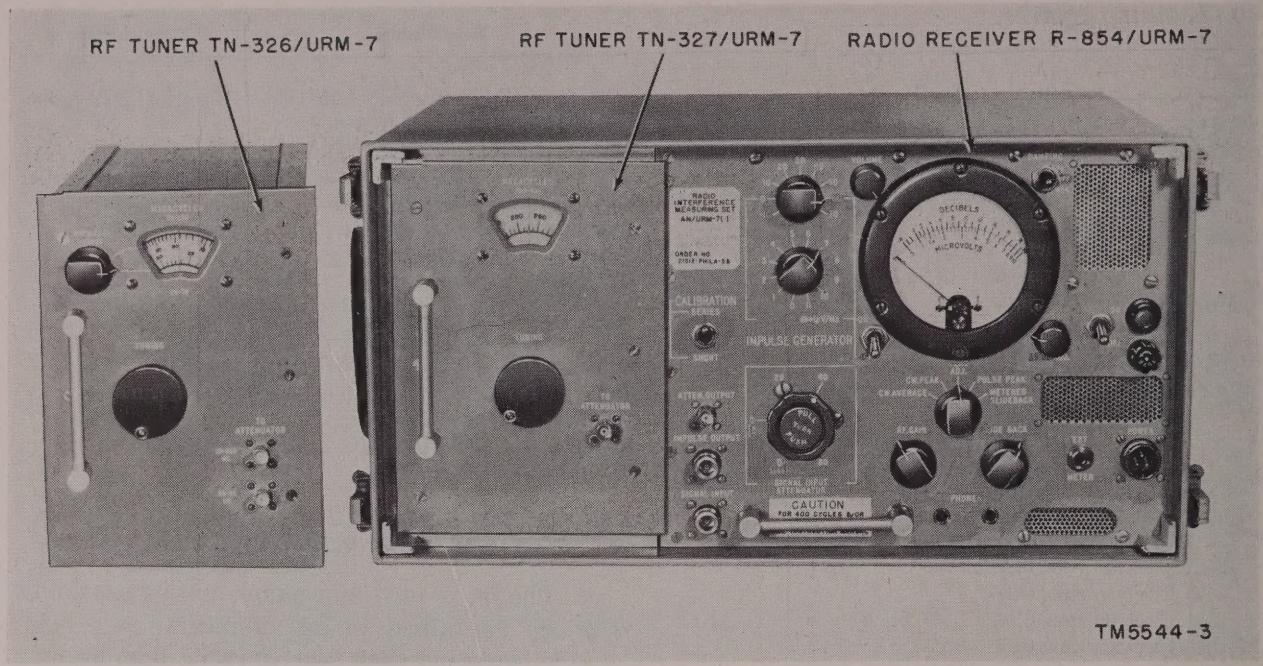


Figure 2. Radio Receiver R–854/URM–7 with Radio Frequency Tuner TN–327/URM–7 in place.

10. Motor-Generator PU–388/G (fig. 3)

a. The motor-generator furnishes the ac power necessary to operate the equipment when the available voltage is 24 volts dc. It is housed in an aluminum case with a handle on the top and louvers on the sides. The top part of the case is fastened to the base by four spring-loaded catches. The motor-generator is mounted on a chassis that holds all the switches and connectors. A separate battery cord is provided to connect the unit to a 24-volt power source.

b. The battery cord is an 8½-foot cord with an AN plug on one end and two battery clips on the other end.

11. Power Isolation and Step-Down Transformer TF–248/G (fig. 3)

a. The transformer is a panel-chassis assembly contained in an aluminum case. The case is equipped with a carrying handle on top.

b. The front panel contains the switches and an ac outlet. A fuse and an ac power cord are on the rear.

12. Minor Components (fig. 3)

a. Antenna AS–922/URM–7 consists of a cone that mounts on a ground plane. On top of the cone are four extensions that accept Mast Sections AB–21/GR. The ground plane has a bracket that allows it to be mounted on the antenna tripod (*g* below). There is also a hinged bracket so that the entire antenna assembly can be tilted.

b. Antenna AS–920/URM–7, the lf antenna, consists of a dipole mechanically connected to a metal box by a 19-inch bakelite tube. The dipole is built to accept an adjustable antenna section which is varied in length to cover the frequency range of the antenna. An adapter block on the bakelite tube is used to mount the antenna on the tripod. A connector on the metal box connects the antenna to the antenna cable.

c. Antenna AS–921/URM–7 is the same as the lf antenna except that the fixed section of the dipole is encased in a plexiglass block.

d. Two adjustable antenna sections are provided which connect to the lf antenna. Each is 42⅛ inches long fully extended and 12¼ inches long fully closed.

e. Two adjustable antenna sections are provided which connect to the hf antenna. Each is 14⅞ inches long fully extended and 6⅛ inches long fully closed.

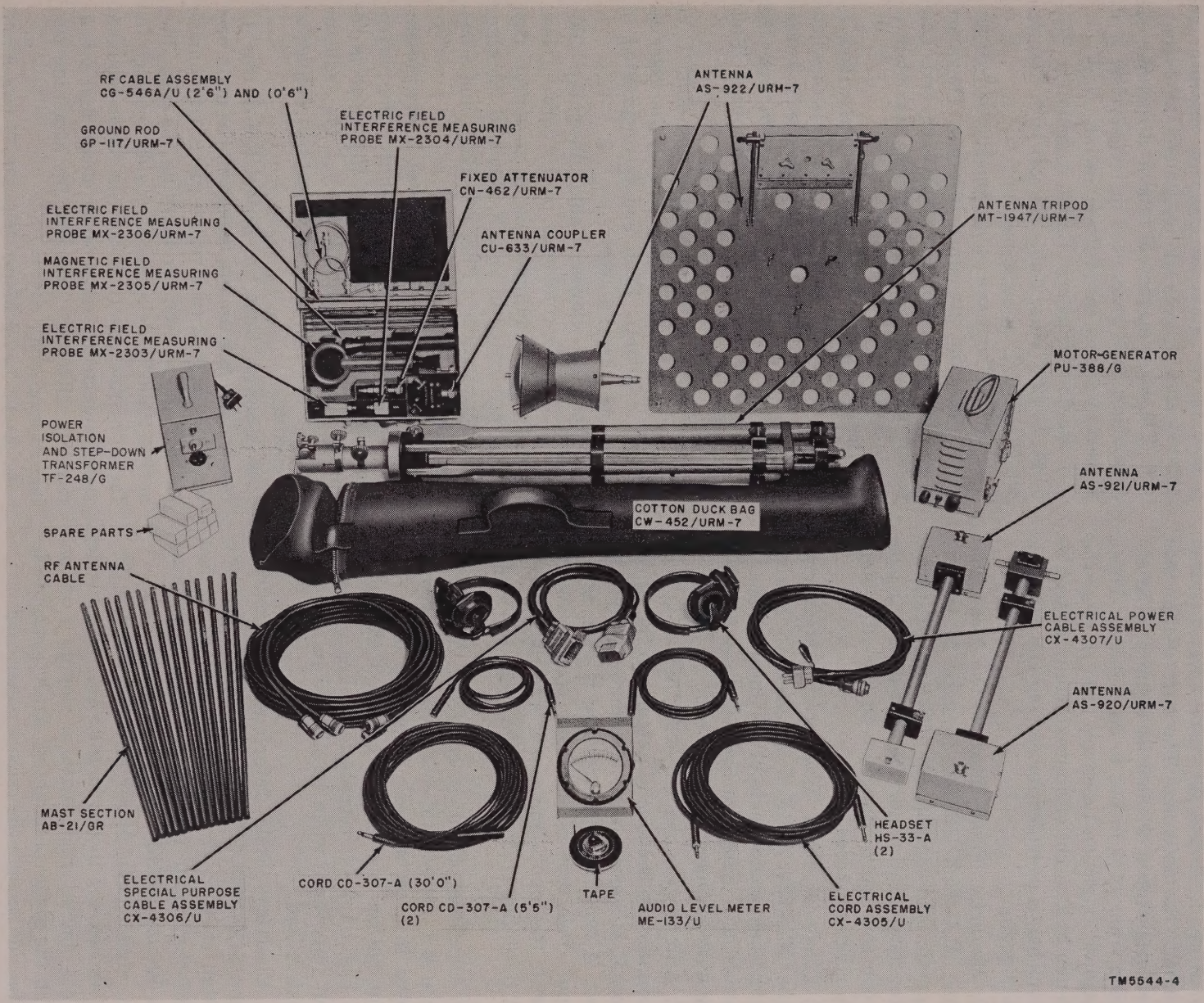


Figure 3. Minor components.

f. Mast Section AB–21/GR is a cylindrical rod with a threaded end. It is connected to the broadband antenna or to the lf antenna.

g. Antenna Tripod MT–1947/URM–7 is used to mount the antennas. The base section has three steel-tipped wooden legs that can be extended from 44½ inches to 58½ inches. Three fiberglass extension tubes are used to raise the antenna to a height of approximately 14 feet. A canvas bag is provided for storing and carrying the tripod.

h. Magnetic Field Interference Measuring Probe MX–2305/URM–7 is used to localize magnetic field components of RF interference. It consists of a cylindrical handle with a loop on one end and a connector on the other end. It is rubber-covered.

i. Electrical Field Interference Measuring Probe MX–2306/URM–7 is used to localize electric field components of RF interference. It consists of a cylindrical bakelite case 8 inches long with a connector at one end.

j. Antenna Coupler CU–633/URM–7 is used to connect the broadband antenna to the equipment. It is housed in an aluminum and plastic block. A type *N* connector plug is used as the output. Two type *N* connector receptacles are used as the input. One connects to the receiver and the other connects to the impulse generator.

k. Electrical Field Interference Measuring Probe MX–2304/URM–7 is a coupling network housed in a rectangular aluminum block. The input end has two binding posts and the output end has a type *N* receptacle. It has a 50-ohm input impedance when terminated in a 50-ohm resistive load.

l. Electrical Field Interference Measuring Probe MX–2303/URM–7 is the same as the 50-ohm coupler (*k* above), except that it has a 500-ohm input impedance when terminated in a 50-ohm resistive load.

m. Audio Level Meter ME–133/U is an aluminum box 4⅝ inches long by 4¼ inches wide by 4¼ inches high, with a sloping face on which the meter is mounted. An AN receptacle on the side accepts the remote meter cord.

n. Fixed Attenuator CN–462/URM–7 is housed in an aluminum case with a type *N* connector at each end.

o. Ground Rod GP–117/URM–7 is a stainless steel rod 12 inches long with a pointed end. A 3-inch bar with flanged ends is inserted through a hole in the stake at the end opposite the pointed end.

p. The steel megacycle tape is a spring-steel measuring tape graduated in megacycles. It is housed in a steel case with a rewind crank.

q. Radio Frequency Cable Assemblies CG–546A/U (2′6″) use Cable RG–5B with Connector UG–88C/U at each end.

r. The RF antenna cable consists of two 30-foot cables that are taped together. There are two UG–18C/U connectors at each end. One is painted with a red band and the other with a green band.

s. Three Cords CD–307–A are provided as headset extension cords. Two are 65 inches long and one is 30 feet long. One end of each is terminated in Telephone Jack JJ–026 and the other end is terminated in Telephone Plug PJ–055B.

t. Electrical Cord Assembly CX–4305/U is used to connect the main unit to the external meter (*x* below). Each end is terminated in Telephone Plug PJ–068.

u. Electrical Power Cable Assembly CX–4307/U, a three-conductor power cord, is used to connect the equipment to an ac source. One end is terminated in an AN plug and the other end is terminated in Plug UP–120M and a battery clip.

v. Electrical Special Purpose Cable Assembly CX–4306/U is used to connect the plug-in tuner to the main unit when the tuner is removed for alinement. A special 17-conductor cable is terminated by a 26-contact connector at each end.

w. Receiver Case CY–2283/URM–7 (fig. 1) is a transit case used to transport the main unit with one plug-in receiver in place. One handle on each end is used for carrying the case. Two spring-loaded catches on each side are used for fastening the cover. A built-in shock-mounted rack protects the unit from shock and vibration. Facilities are provided for attaching two legs at each end.

x. Audio Level Meter ME–133/U is a duplicate of the front-panel meter on the main unit. It is housed in a steel case that has a sloping front.

y. Electrical Equipment Case CY–2284/URM–7 is a transit case used to transport the accessory components. One handle at each end is used for carrying the case. Eight spring-loaded catches fasten the cover.

z. Tuner Case CY–2282/URM–7 is used to transport the tuner that is not plugged into the main unit. One handle at the top is used to carry the case. Four spring-loaded catches fasten the cover. A built-in shock-mounted rack protects the unit from shock and vibration.

CHAPTER 2
OPERATION

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

13. Unpacking

a. Packaging Data. When packaged for shipment, the components of Radio Interference Measuring Set AN/URM–7 are placed in cartons and packed in four wooden cases. A typical shipping case and its contents are shown in figure 4. The following chart gives the dimensions and contents of the shipping crates.

Case No.	Dimensions (in.)	Volume (cu ft)	Unit weight (lb)	Contents
1 of 4	17x21x32	6.7	121	Antennas, probes, and accessories.
2 of 4	13½x16x20	2.5	30	Hf tuner.
3 of 4	17x30x30	9.0	103	Receiver with lf tuner.
4 of 4	11x11x50	3.5	19	Antenna tripod.
Total weight			273	

b. Removing Contents. Equipment may be shipped in oversea or domestic packing cases. When new equipment is received, select a location that is convenient to permanent or semipermanent installation where the equipment may be unpacked without exposure to the elements.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged, a complete overhaul may be required or it may be made useless.

(1) Cut and fold back the metal straps.

(2) Remove the nails from the top and one side of the case with a nailpuller. Remove the top and one side. Do not pry off the side and the top; prying may damage the equipment.

(3) Open the waterproof barrier and remove the outer carton.

(4) Open the outer carton and the moisture-vaporproof barrier and remove the inner carton.

(5) Open the inner carton and remove its contents.

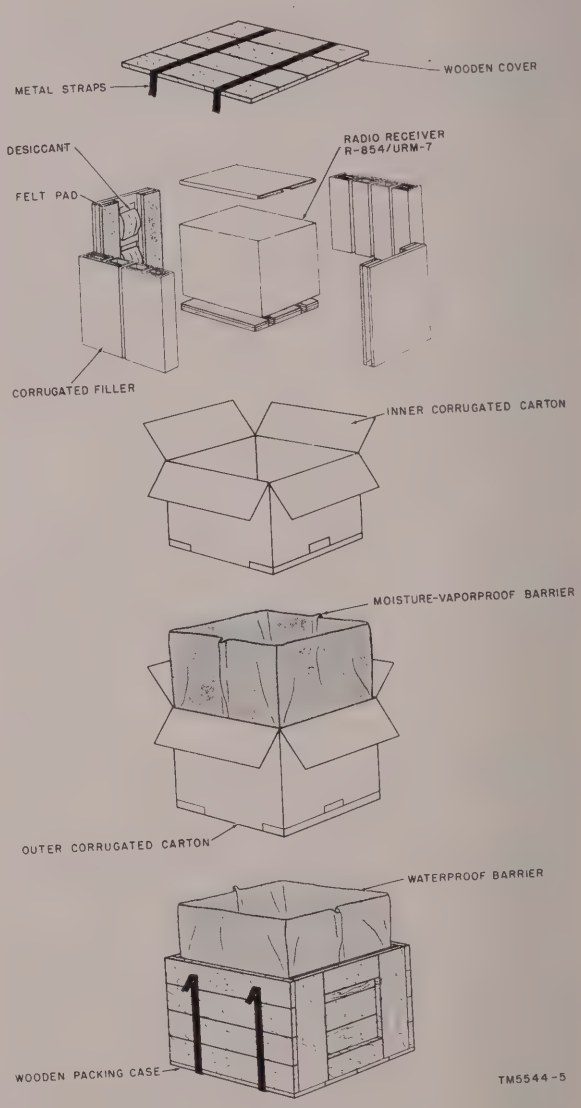


Figure 4. Typical packaging.

14. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, refer to paragraph 2.

b. Check the equipment against the packing list. If there is no packing list, use the table of

components (par. 5) and/or the packaging data (par. 12*a*) as a general check.

c. See that all tubes are inserted in the proper sockets (figs. 13, 14, and 15).

d. Be sure that a 2-ampere fuse is in the fuse holder on the front panel.

15. Setting Up Test Set

a. Place the three transit cases and the tripod bag near the equipment or site to be tested.

b. Remove the cover from Receiver Case CY–2283/URM–7 and insert the four legs to make a stand for the main unit.

c. If the correct tuner is plugged into the main unit, leave it; otherwise exchange it with the tuner in Tuner Case CY–2282/URM–7.

d. Remove the tripod from the canvas bag and stand it up.

16. Connections

(fig. 5)

Caution: Be sure that the power switches on the transformer (if used) and the main unit are set at OFF.

a. Operation From 24-Volt Dc Supply.

(1) Connect the dc power cable from the INPUT receptacle on the motor-generator to a 24-volt battery. The battery clips on the cable are marked red for positive and black for negative.

(2) Connect the ac power cable from the POWER receptacle of the main unit to the ac receptacle on the motor-generator.

(3) Connect the six-inch RF cable from TO ATTENUATOR jack on the front

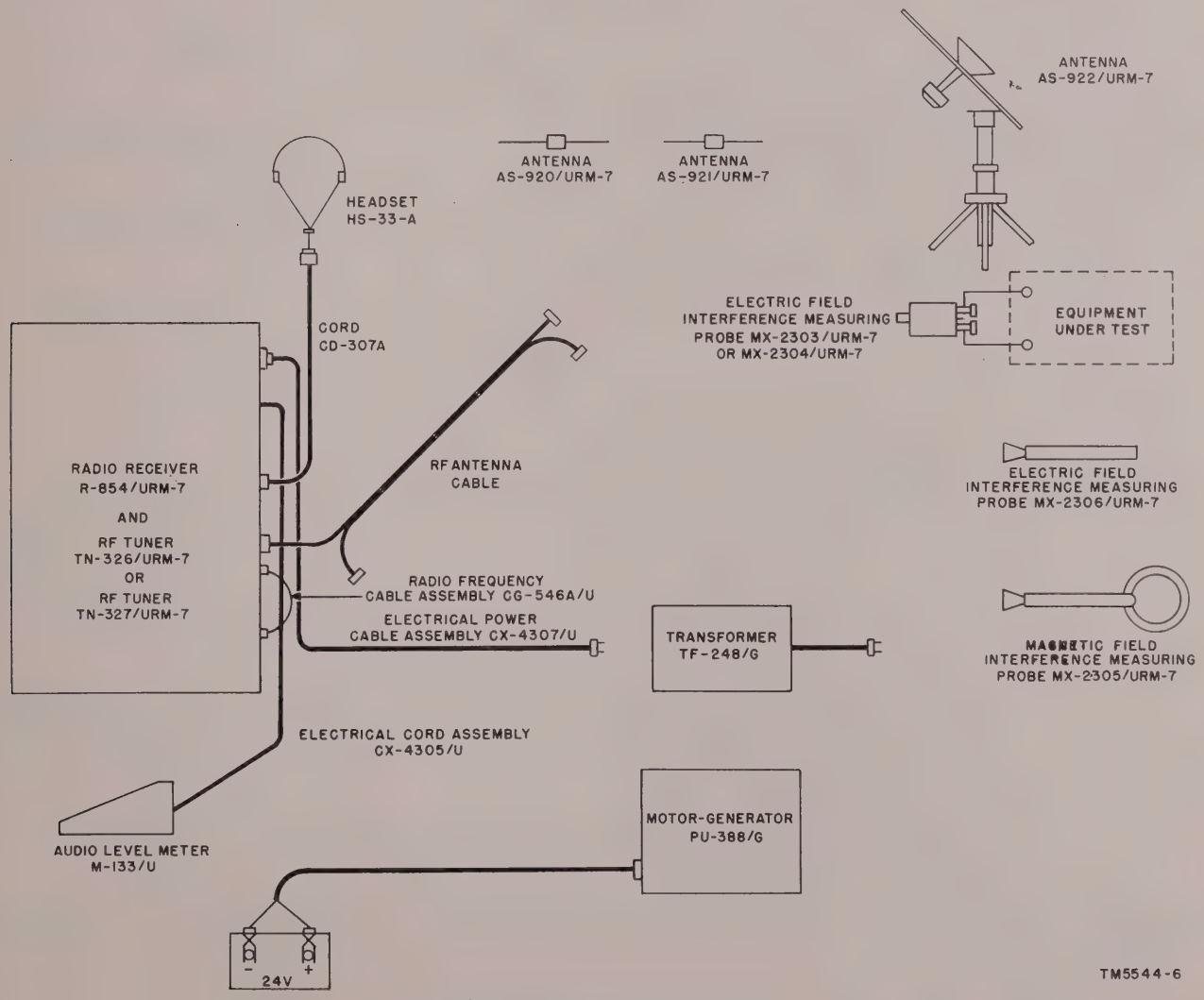


Figure 5. Connection diagram.

of the tuner to ATTEN OUTPUT jack on the main unit.

(4) Connect either Cord CD–307–A from a PHONES jack on the main unit to the plug on the headset.

b. Operation From 115-Volt, 360 to 420 Cps or 230-Volt, 48 to 400 Cps Ac Supply.

(1) Set the 115-volt to 230-volt switch on the front panel of the transformer (fig. 8) to the left for 115-volt operation or to the right for 230-volt operation.

(2) Plug the power cord on the transformer into an ac receptacle.

(3) Connect the ac power cord from the POWER receptacle of the main unit to the AC OUTPUT receptacle on the transformer.

(4) Connect the six-inch RF cable from TO ATTENUATOR jack on the front of the lf tuner to ATTEN OUTPUT jack on the main unit.

(5) Connect either Cord CD–307–A from PHONES jack on the main unit to the headset.

c. Operation From 115-Volt, 60 Cps Ac Supply. Connect the ac power cord from the POWER receptacle of the main unit directly to the ac outlet.

d. Connections for Antennas, Couplers, and Probes. Connecting the antennas and other accessories are part of the operating procedures (pars. 21–28).

Section II. CONTROLS AND INSTRUMENTS

17. General

This section describes, locates, and illustrates the controls and instruments provided for the proper operation of the equipment. The various types of operation are described in paragraphs 21 through 28.

18. Radio Interference Measuring Set AN/URM–7 Operating Controls

a. Main Unit (fig. 6).

Control or indicator	Function
Power switch	Turns test set on or off.
Function switch.	Has five positions to select type of operation of meter.
	Position — *Function*
	CW. AVERAGE — Measures average envelope voltage of cw signal.
	CW. PEAK — Measures peak envelope voltage of cw signal.
	ZERO ADJ. — Permits meter to be zeroed with ZERO ADJ. control.
	PULSE PEAK — Measures peak envelope voltage of a pulse signal.
	METER SLIDEBACK. — Permits use of SLIDE BACK control.
ZERO ADJ. control.	Used to set meter pointer at zero before making tests.
SLIDE BACK control	Used for certain types of measurements when it is necessary to reduce an audible signal to the threshold of audibility.
RF GAIN control	Adjusts gain of test set so that meters can be calibrated against output of impulse generator.
IMPULSE GENERATOR: Switch	Turns impluse generator on or off.
Coarse output control	Varies output of impulse generator in 10-db steps.
Fine output control	Varies output of impulse generator in 1-db steps.
SIGNAL INPUT ATTENUATOR switch	Provides 5 degrees of attenuation of input signal; 0 db, 20 db, 40 db, 60 db, and 80 db. Also has position, marked O SUBST, used for using broadband types of signal substitution techniques.
CALIBRATION switch	In SERIES position, permits reception of external signals. In SHUNT position, permits calibration of test set against output of internal impulse generator.

b. HF Tuner (fig. 6).

Control or indicator	Function
TUNING control	Tunes test set to receive signals within the range of 200 to 400 mc.
MEGACYCLES dial	Indicates frequency to which test set is tuned.

c. LF Tuner (fig. 7).

Control or indicator	Function
TUNING control	Tunes test set to receive signals within the range of 20 to 220 mc.
FREQUENCY RANGE control.	Selects frequency range of either 20 to 70 mc or 70 to 220 mc.
MEGACYCLES dial	Indicates frequency to which test set is tuned.

d. Transformer (fig. 8).

Control	Function
Power switch	Turns transformer on or off.
115V–230V switch	Connects transformer for operation with either 115-volt or 230-volt input.

e. Motor Generator.

Control	Function
Power switch	Turns motor-generator on or off.

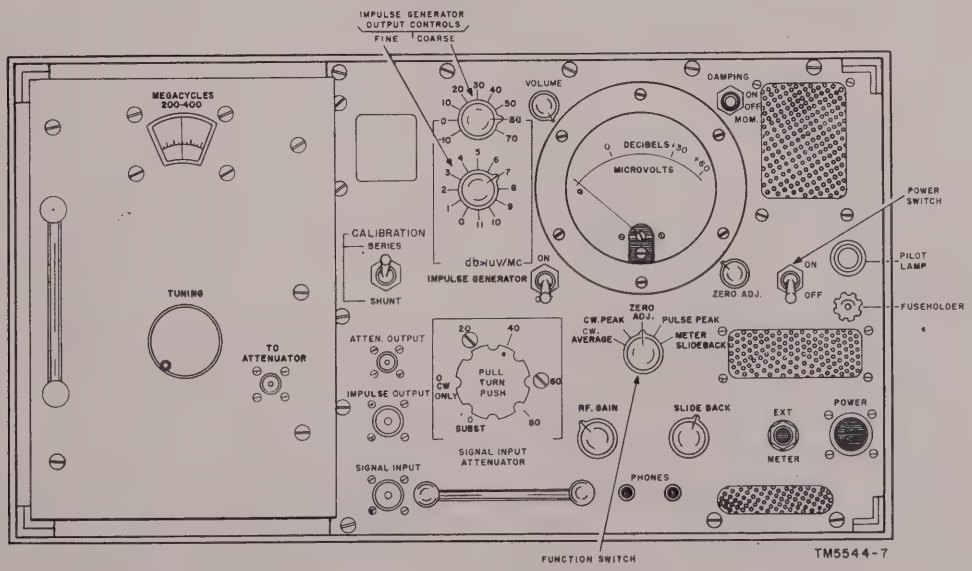


Figure 6. Hf tuner and main unit, operating controls and indicators.

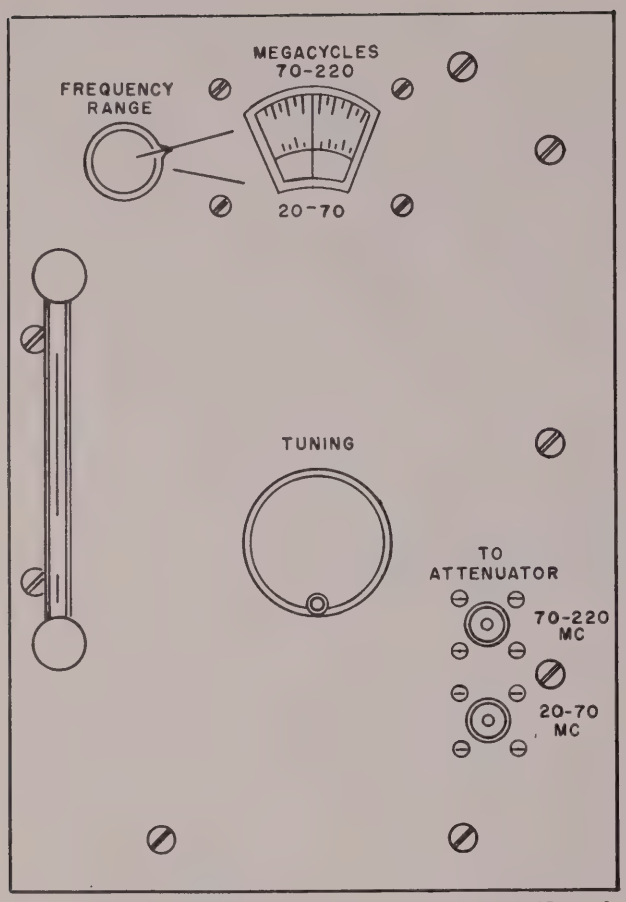


Figure 7. Lf tuner, operating controls and indicator.

Figure 8. Transformer, operating controls.

Section III. OPERATING INSTRUCTIONS

19. Siting

When the equipment is used for interference measurements, it should be located in accordance with the applicable test specification. For field intensity measurements, choose a site that is free from trees, electrical power lines, metal fences, buildings, and other obstacles that might interfere with the field strength pattern.

20. Starting and Calibrating Procedures

a. Starting. With the equipment set up for operation (par. 15) and connected (par. 16)—

(1) Be sure that the power switch on the main unit is at OFF.

(2) Turn the VOLUME and RF. GAIN controls fully counterclockwise.

(3) Plug a headset into one of the PHONES jacks.

(4) Set the power switch on the transformer or motor-generator, if used, at ON.

(5) Set the power switch on the main unit at ON and allow a 15-minute warm-up.

b. Calibration.

Caution: Pull out the SIGNAL INPUT ATTENUATOR control knob before turning it. Turning without first pulling forward will damage the attenuator. After the dot on the control knob is lined up with the desired position, push the knob all the way in.

(1) Set the front panel controls as follows:

Control	Position
Function switch	ZERO ADJ.
IMPULSE GENERATOR switch	OFF.
SIGNAL INPUT ATTENUATOR control.	20.
CALIBRATION switch	SHUNT.
DAMPING switch	OFF.
SLIDE BACK control	Fully counterclockwise.

(2) Adjust the ZERO ADJ. control until the meter pointer is at 0 microvolts.

(3) Set the function switch at PULSE PEAK.

(4) Set the TUNING control on the tuner to the desired frequency.

(5) Refer to the two-terminal voltmeter chart (fig. 9). Obtain the impulse generator output setting for the desired frequency and set the impulse generator coarse and fine output controls accordingly.

(6) Set the IMPULSE GENERATOR switch at ON.

(7) Adjust the RF. GAIN control for a full-scale reading on the meter.

(8) Set the IMPULSE GENERATOR switch at OFF.

(9) The test set is now calibrated for a full-scale meter deflection of 40 db above 1 microvolt (100 μv) at the frequency used. Do not disturb the setting of the RF. GAIN control until a measurement is completed. If the frequency setting is changed, recalibrate at the new frequency ((3)–(8) above).

21. Measurement of Narrow-Band Conducted Signals

The 50- and 500-ohm couplers are used to measure cw signals conducted in wire circuits, such as power lines and audio-frequency lines.

Caution: Do not connect the couplers across a source of more than 500 volts.

a. Start the test set and calibrate it for a full-scale deflection of 40 db above 1 μv (par. 20).

b. Set the CALIBRATION switch at SERIES and set the function switch at CW. AVERAGE or CW. PEAK, as required.

c. Attach the green connector at one end of the RF antenna cable to the SIGNAL INPUT jack. Attach the green connector at the other end of the RF antenna cable to the jack on the 50-ohm coupler if a low-impedance circuit is to be measured. If the impedance is higher than 150 ohms, use the 500-ohm coupler.

Note. If the impedance of the circuit under test is unknown, make the test with both couplers. Use the higher of the two readings. Make proper note of the coupler that gave the higher reading in any tabulation of the results.

d. Connect the binding posts on the coupler to the line under test. Use the shortest possible leads.

e. Note the meter reading. If the pointer is off scale at the right end, set the SIGNAL INPUT ATTENUATOR to the higher steps until an on-scale reading is obtained. If the pointer is still off scale with the attenuator set at 80, insert the external pad between the RF antenna cable and the SIGNAL INPUT jack. This extends the range of the meter by 40 db.

f. If the meter pointer indicates less than 0 on the db scale, turn the SIGNAL INPUT ATTENUATOR to 0 CW ONLY. If the meter still indicates less than 0 db, the required measurement is outside the range of the test set.

g. It is possible that the meter will indicate more than 0 db because of noise generated within the test set. Set the CALIBRATION switch at SHUNT. If there is no change in the meter indication, the meter is being actuated by internal noise, and no signal is being received.

h. If the meter indication drops less than 6 db when the CALIBRATION switch is moved from SERIES to SHUNT, a correction must be made to the first meter reading (*e* above). From the first meter reading, which is signal plus noise (S + N), subtract the reading that resulted after the leads were removed, which is internal noise (N). The result is (S + N) minus (N). Refer to figure 10. Determine the db correction factor for the (S + N) minus N just calculated, and subtract it from the first meter reading (*e* above). Use the result as the meter reading in the signal-level calculation in *i* below.

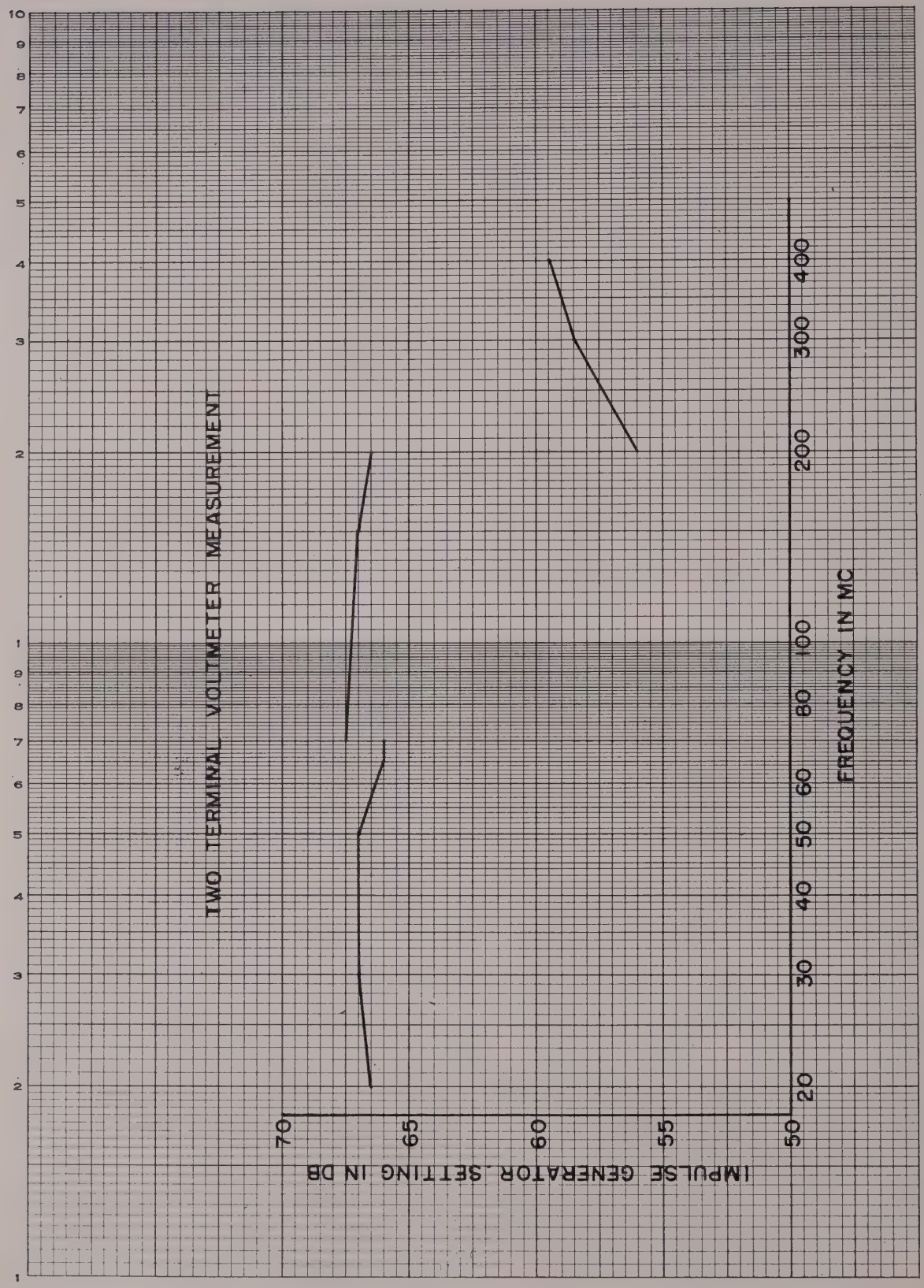


Figure 9. Two-terminal voltmeter chart.

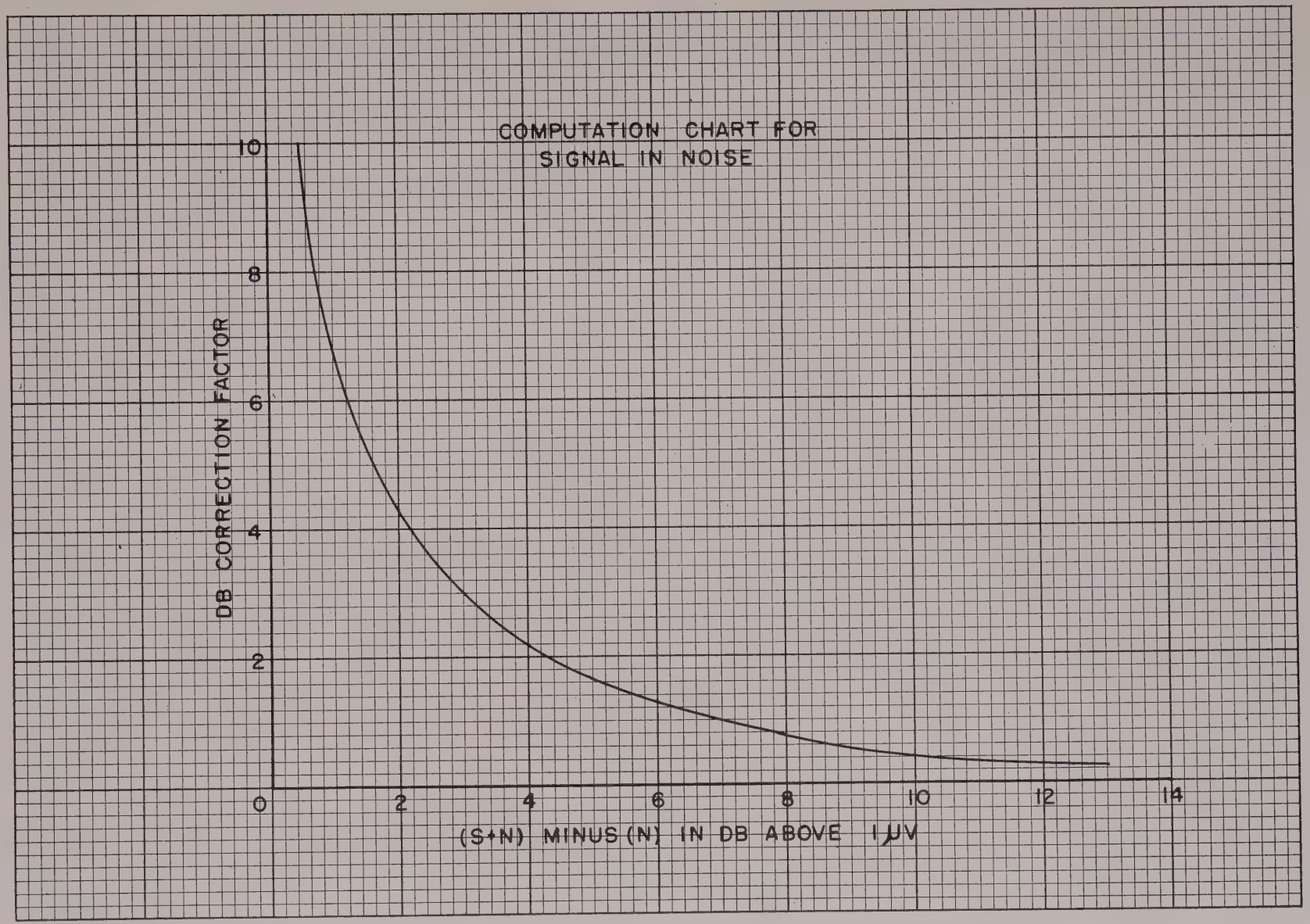


Figure 10. Computation chart for signal in presence of noise.

i. Calculate the level of the signal being measured in db above 1 μv as follows:

Meter reading in db + SIGNAL INPUT ATTENUATOR setting in db + (26 db if 500-ohm coupler is used; 40 db if external pad is used)

Example:

Meter reading	12 db
SIGNAL INPUT ATTENUATOR	40 db
500-ohm coupler used	26 db
External pad not used	0 db
Total	78 db

The above total is the signal level in db above 1 μv.

j. Repeat the procedures given in *a* through *i* above for each frequency to be measured.

22. Measurement of Broadband Conducted Signals

The 50- and 500-ohm couplers are used to measure broadband RF signals conducted in wire circuits, such as power lines and audio-frequency lines.

a. Start and calibrate the test set as instructed in paragraph 20, except set the coarse impulse generator output control at 60 and the fine output control at 0. Use these settings for all frequencies to be measured.

b. Set the CALIBRATION switch at SERIES and set the function switch at PULSE PEAK.

c. Perform the procedures given in paragraph 21*c* through *g*.

d. Calculate the level of the signal being measured as follows:

20 db + meter reading in db + SIGNAL ATTENUATOR setting in db +26 db (if 500-ohm coupler is used).

Example:

Constant	20 db
Meter reading	12 db
SIGNAL INPUT ATTENUATOR	20 db
500-ohm coupler used	26 db
Total	78 db

The above total is the signal level in db above 1 μv/mc.

e. Repeat the procedures given in *a* through *d* above for each frequency to be measured.

23. Narrow-Band, Far-Field Measurements

To measure the field strength of a cw signal (with or without its intended modulation)—

a. Start and calibrate the test set (par. 20).

b. Set up the tripod within 30 feet of the test set.

c. In accordance with the frequency to be measured, mount the correct antenna on the tripod.

(1) For frequencies between 20 and 200 mc, use the lf antenna.

(2) For frequencies between 200 and 400 mc, use the hf antenna.

d. Connect the two adjustable antenna sections to the antenna mounting block.

e. Using the steel megacycle tape, adjust the length of the dipole arms for the frequency to be measured.

Note. In the frequency range of 20 to 70 mc, add Mast Sections AB–21/GR as required to extend the dipole arms to the proper length.

f. Using the green connectors, connect the RF antenna cable between the SIGNAL INPUT jack and the antenna. Set the CALIBRATION switch at SERIES and set the function switch at CW. AVERAGE or CW. PEAK as required.

g. Orient the antenna horizontally and vertically to obtain a maximum reading on the meter. If the meter pointer deflects off scale to the right, set the SIGNAL INPUT ATTENUATOR to a higher value until an on-scale reading is obtained. If an on-scale reading cannot be obtained with the SIGNAL INPUT ATTENUATOR at 80, insert the external pad (par. 21*e*) and add 40 db to the signal-level calculation (*i* below). If the pointer indicates less than 0 db, refer to paragraph 21*f*.

h. Set the CALIBRATION switch at SHUNT. If the meter indication drops less than 6 db, refer to paragraph 21*h*.

i. From the dipole antenna coefficient chart (fig. 11) obtain the coefficient for the frequency being measured and calculate the signal level as follows:

Meter reading + SIGNAL INPUT ATTENUATOR setting + dipole coefficient.

Example:

Meter reading	15 db
SIGNAL INPUT ATTENUATOR	20 db
Dipole antenna coefficient	5 db
Total	40 db

The above total is the signal level in db above 1 μv/meter.

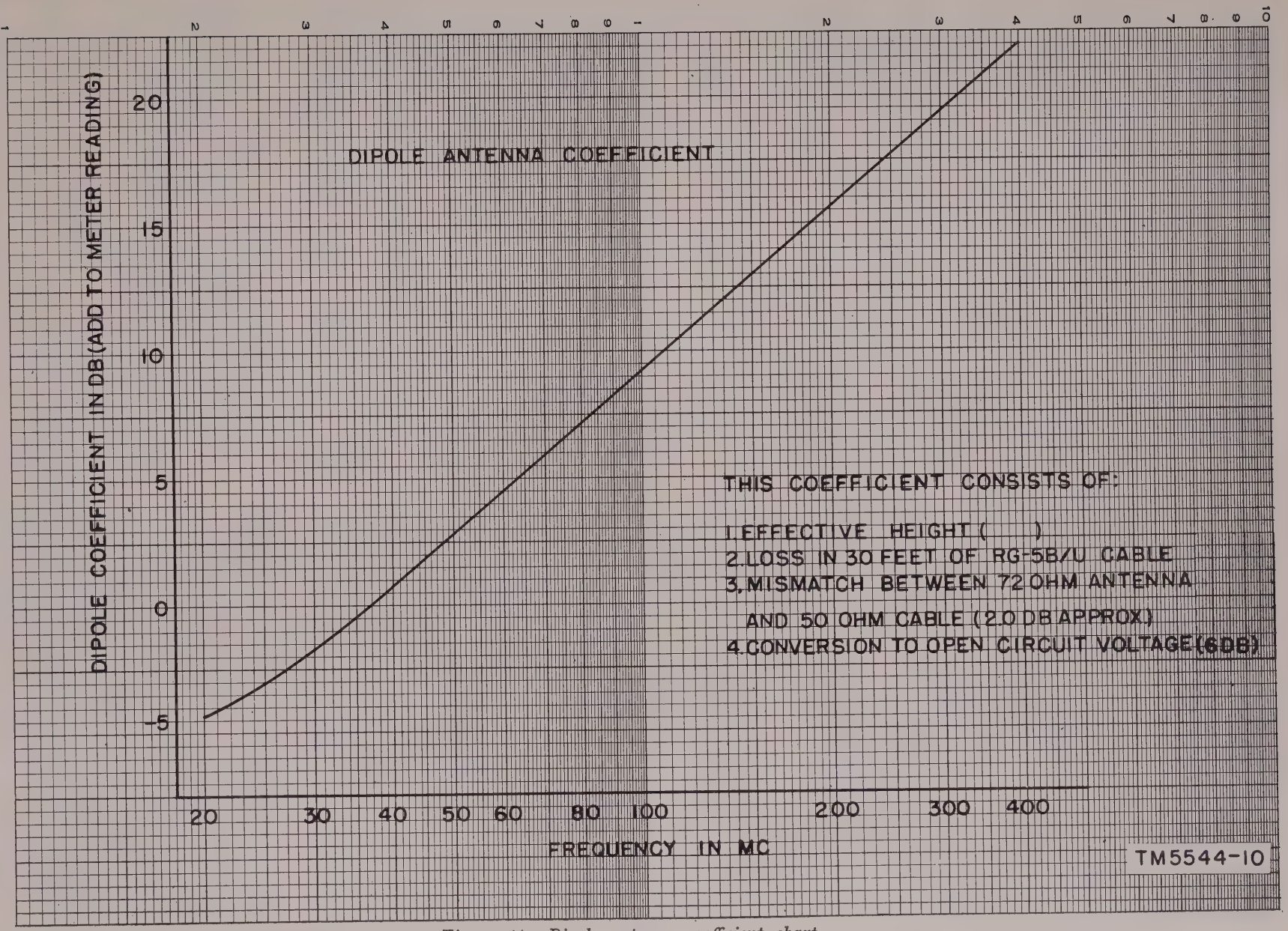


Figure 11. Dipole antenna coefficient chart.

j. Repeat the procedures given in *a* through *i* above for each frequency to be measured.

24. Broadband, Far-Field Measurements

To measure broadband signals at a given site—

a. Start and calibrate the test set (par. 20) except set the coarse impulse generator output control at 60 and set the fine control at 0. Use these settings for all frequencies to be measured. Set the CALIBRATION switch at SERIES.

b. Perform the procedures given in paragraph 23*b* through *g*.

c. Calculate the level of the signal being measured as follows:

20 db + meter reading in db + SIGNAL INPUT ATTENUATOR setting in db + dipole coefficient (fig. 11)

Example:

Constant	20 db
Meter reading	15 db
SIGNAL INPUT ATTENUATOR	20 db
Antenna coefficient	5 db
Total	60 db

The above total is the signal level in db above 1 μv/mc/meter.

d. Repeat the procedures given in *a* through *c* above for each frequency to be measured.

25. Narrow-Band, Near-Field Measurements

To measure narrow-band signals in a near field—

a. Start and calibrate the test set (par. 20).

b. Mount the discone antenna on the tripod.

c. Install Mast Sections AB–21/GR in the peripheral sockets of the cone for the frequency to be measured as follows:

Frequency	Sections
20 to 40 mc	3 sections in each socket.
40 to 95 mc	2 sections in each socket.
95 to 300 mc	1 section in each socket.
Above 300 mc	None.

Note. Do not use the center socket of the cone.

d. Connect the unbalanced injection block to the jack on the bottom of the antenna.

e. Connect one end of the RF antenna cable to the unbalanced injection block, mating the red connector with the IMP GEN jack and the green connector with the SIG jack. Connect the other end of the RF antenna cable to the main unit, mating the red connector with the IMPULSE OUT jack and the green connector with the SIGNAL INPUT jack.

f. Set up and orient the antenna in accordance with the applicable specification.

g. Set the CALIBRATION switch at SERIES.

h. Set the function switch at CW. PEAK or CW. AVERAGE as required.

i. Turn on the source of the signal to be measured.

j. Vary the setting of the SIGNAL INPUT ATTENUATOR between 0 CW. ONLY and 80 for an on-scale reading on the meter. If the meter still deflects to the right with the SIGNAL INPUT ATTENUATOR at 80, insert the external pad between the SIGNAL INPUT jack and the RF antenna cable and add 40 db to the calculation in *l* below. If the meter indicates less than 0 db, refer to paragraph 21*f*.

k. Set the CALIBRATION switch at SHUNT. If the meter indication drops less than 6 db, refer to paragraph 21*h*.

l. Calculate the antenna open-circuit voltage as follows:

Meter reading + SIGNAL INPUT ATTENUATOR

Example:

Meter reading	12
SIGNAL INPUT ATTENUATOR	40
Total	52

The above total is the antenna open circuit voltage in db above 1 μv.

m. Repeat the procedures given in *a* through *k* above for each frequency to be measured.

26. Broadband, Near-Field Measurements

To measure broadband signals in a near field—

a. Start the test set (par. 20*a*).

b. Set up the tripod and discone antenna as instructed in paragraph 25*b* through *f*.

c. Set the function switch at PULSE PEAK and set the RF. GAIN control at about mid-position.

d. Turn on the source of the signal to be measured.

Note. If radio-station or other cw interference is present, retune the test set as necessary to get away from the interference.

e. Set the SIGNAL INPUT ATTENUATOR at a position that gives an on-scale indication on the meter; however, do not use the 0 CW. ONLY position. If the meter deflects off-scale to the right, insert the external pad between the RF antenna cable and the SIGNAL INPUT jack and add 40 db to the calculation in *l* below.

f. Adjust the RF. GAIN control for a 10-db meter indication.

g. Turn off the source of the signal being measured.

h. If the SIGNAL INPUT ATTENUATOR is at 0 SUBST or 20, leave it alone. If it is at 40, 60, or 80, set it to 20. Add the difference to the calculated value in *l* below.

i. Set the IMPULSE GENERATOR switch at ON.

j. Turn the coarse impulse generator output control until the meter indication is between 0 and 10 db.

k. Turn the fine impulse generator output control for an exact 10-db meter indication.

l. Calculate the antenna open-circuit voltage produced by the signal being tested as follows:

Impulse generator output controls setting
+ difference found in *h* above.

Example:

Impulse generator output	32 db
Difference from *h* above	20 db
Total	52 db

The above total is the antenna open-circuit voltage produced by the signal being tested in db above 1 μv/mc.

m. Repeat the foregoing procedures for each frequency to be tested.

27. Measuring More Than One Level at One Frequency

To measure more than one broadband signal (at different levels) at one frequency—

a. Start the test set (par. 20*a*) and set up the discone antenna as instructed in paragraph 25*b* through *f*.

b. Set the function switch at PULSE PEAK and set the RF. GAIN control at about mid-position. Be sure that the SLIDE BACK control is fully counterclockwise.

Note. If radio-station or other cw interference is present, retune the test set as necessary to get away from the interference.

c. Turn on the source of the signals to be measured. Adjust the VOLUME control for a comfortable listening level.

h. Turn the coarse impulse generator output until the lowest level signal becomes barely audible.

e. Shut off the source of the signal under test.

f. Set the IMPULSE GENERATOR switch at ON.

g. Set the fine impulse generator output control at 0.

h. Turn the coarse impulse generator output control until the calibrating signal is heard in the headset. Turn the control one step counterclockwise.

i. Turn the fine impulse generator output control clockwise until the calibrating signal becomes barely audible. Turn the control one step counterclockwise.

j. The antenna open-circuit voltage produced by this lowest level signal is the setting of the impulse generator output controls.

k. Repeat the foregoing procedures for each successively higher signal level.

28. Localization of Noise

To pin-point sources of interference generated by various types of machinery or electronic equipment—

a. Connect the RF antenna cable between the SIGNAL INPUT jack on the main unit and the electrical field probe; use the green connectors.

b. Tune the test set to the frequency to be checked.

c. Turn the RF. GAIN control fully clockwise.

d. Set both impulse generator output controls at 0 db.

e. Set the CALIBRATION switch at SERIES.

f. Turn on the equipment under test; adjust it for the desired operating conditions.

g. Move the electrical field probe slowly around the equipment under test until a signal is heard. Move the probe in the pick-up area until maximum signal is heard. The probe is now closest to the source of RF interference. Cover the entire equipment in the same manner.

h. Remove the RF antenna cable from the electrical field probe and attach it to the magnetic field probe.

i. Repeat the procedure given in *g* above. Revolve the loop through 180° to obtain maximum pick-up; the magnetic field probe is directional.

j. Repeat the foregoing procedures for each frequency to be checked.

29. Stopping Procedure

a. Set the power switch on the main unit to OFF.

b. If the transformer is in use, set its power switch to the OFF position (down).

c. If the motor-generator is in use, set its power switch to the off position (down) and remove the battery cord from the battery.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE

Section I. TOOLS AND EQUIPMENT

30. Tools, Materials, and Equipment Required

The following tools, materials, and test equipment are required for organizational maintenance.

a. Tools.

Tool Equipment TE–113

b. Materials.

Cheesecloth, bleached, lint-free
Sandpaper, flint, No. 000
Cleaning Compound (Federal stock No. 7930–395–9542)

c. Test Equipment. A common usage name is indicated after each component.

Nomenclature	*Common name*
Electron Tube Test Set TV–7/U	Tube tester
Multimeter ME–77/U	Multimeter

31. Special Tools Supplied

An N connector alinement tool is supplied with the test set. If the connectors will not mate because of misalinement, insert the male end of the tool into the male connector, and then remove the tool and insert its female end into the female connector. Remove the tool; the connectors will now mate.

Section II. PREVENTIVE MAINTENANCE SERVICES

32. Preventive Maintenance

a. DA Form 11–266. DA Form 11–266 (fig. 12) is a preventive maintenance checklist to be used for organizational maintenance. Items not applicable to the equipment are lined out in the figure. References to the ITEM block in the figure are to paragraphs that contain additional maintenance information pertinent to the particular item. Instructions for its use are on the form.

b. Items. The information shown in this subparagraph is supplementary to DA Form 11–266. The item numbers correspond to the ITEM numbers on the form.

Item	Maintenance procedures
1	Use clean cheesecloth to remove dust, dirt, and grease from the antenna, tripod, headsets, and front panel controls. If necessary, wet the cloth with Cleaning Compound; wipe the parts with a dry, clean cloth.
3	All control knobs should work smoothly, be tight on the shafts, and should not bind. Tighten all loose knobs and be sure that the knobs do not rub against the panel.
5	Repair any cuts in the power-cord insulation by covering them with rubber tape and then with friction tape. Replace or repair a broken power cord or RF cable.
10	Remove all rust from components with Cleaning Compound or sandpaper as required; touch up bare spots with paint.
17	Inspect the variable capacitors in the hf tuner for dirt, moisture, or loose mountings.
20	Use Cleaning Compound to clean the windings and the sliding contacts of the variable tuning inductors in the lf tuner.

Warning: Cleaning Compound is flammable and its fumes are toxic. Do not use near a flame and provide adequate ventilation

33. Lubrication

No lubrication is required. The bearings in the motor-generator are lubricated at the factory and sealed.

LEGEND for marking conditions:
Satisfactory, ✓
Adjustment, Repair or Replacement required, X.
Defect corrected, (X).

DAILY CONDITION FOR MONTH OF MAY 1958

NO.	DAILY ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2D 3D ECHELON
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
1.	CLEAN DIRT AND MOISTURE FROM EXPOSED SURFACES OF HOUSINGS, CASES, CABINETS, CONTROL PANELS, INTERCONNECTING PLUGS, CABLES, HEADSETS, METER WINDOWS, ETC. PAR. 32 b	CD	CD	CD	CD	CD	CD	CD	DL									✓
2.	INSPECT FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS SWITCHES, KNOBS, JACKS, CONNECTORS AND PILOT LIGHTS.	CD	CD	CD	CD	CD	CD	CD	DL									✓
3.	INSPECT CONTROLS FOR BINDING, SCRAPING. TAP CONTROLS LIGHTLY FOR CUT-OUT DUE TO LOOSE CONTACTS. PAR. 32b	CD	CD	CD	CD	CD	CD	CD	DL									✓
4.	DURING OPERATION BE ALERT FOR ANY UNUSUAL PERFORMANCE OR CONDITION.	CD	CD	CD	CD	CD	CD	CD	DL									✓

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	2D 3D ECH
5. INSPECT CORDS, CABLES, WIRE AND SHOCK MOUNTS FOR BREAKS, CUTS, KINKS, DETERIORATION, STRAIN AND FRAYING. PAR. 32b	✓					✓
6. INSPECT CANVAS ~~AND LEATHER~~ ITEMS FOR FUNGUS, FRAYING, TEARS. BROKEN ZIPPERS AND SNAP FASTENERS.	✓					✓
7. HAND CHECK FOR LOOSENESS OF EXTERIOR ITEMS SUCH AS HANDLES, LATCHES ~~HINGES.~~	✓					✓
8. ~~INSPECT FOR LUBRICATION IN ACCORDANCE WITH APPLICABLE DA LUBRICATION ORDER.~~						
9. ~~INSPECT DRY BATTERIES FOR DIRT, LOOSE TERMINALS AND LEAKAGE.~~						
10. INSPECT EXPOSED METAL SURFACES FOR RUST AND CORROSION. PAR. 32b	(X)					✓
11. INSPECT METERS FOR DAMAGED GLASS AND CASES.	✓					✓

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
12. INSPECT SEATING OF READILY ACCESSIBLE ITEMS OF A PLUCK-OUT NATURE: CRYSTALS, FUSES, CONNECTORS, ~~PLUG-IN COILS~~, LAMPS, ETC. DO NOT REMOVE, ROCK OR TWIST TO INSPECT. USE ONLY A DIRECT PRESSURE TO INSURE THE ITEM IS FULLY SEATED.	
13. INSPECT FOR CLEANLINESS AND TIGHTNESS OF SUCH ITEMS AS SHOCK MOUNTS, ANTENNA, ANTENNA MOUNTS, ~~AND WAVE GUIDES.~~	
14. ~~INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR DIRT, CORROSION, WORN OR BURNED CONTACTS.~~	

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
15. INSPECT RESISTORS, BUSHINGS, INSULATORS FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	✓
16. INSPECT JACKS AND CONNECTORS FOR SNUG FIT AND GOOD CONTACTS.	(X)
17. INSPECT VARIABLE CAPACITORS FOR DIRT AND MOISTURE. PAR. 32b	✓
18. ~~INSPECT AIR FILTERS FOR CLEANLINESS.~~	
19. ~~INSPECT SCREWTYPE TERMINALS OF TRANSFORMERS, FIXED CAPACITORS, RESISTORS, CHOKES, POTENTIOMETERS AND RHEOSTATS FOR CORROSION, DIRT AND LOOSE CONTACTS.~~	
20. CLEAN AND TIGHTEN SWITCHES, ~~BLOWERS,~~ RELAY CASES; CLEAN INTERIOR OF CHASSIS AND CABINETS. PAR. 32 b	✓
21. INSPECT GENERATORS, MOTORS ~~AND DYNAMOTORS~~ FOR BRUSH WEAR, SPRING TENSION, ARCING AND COMMUTATOR WEAR.	✓
22. ~~INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.~~	
23. INSPECT GASKETS ~~AND BUSHINGS~~ FOR WEAR AND DAMAGE.	✓
24. ~~INSPECT CATHODE RAY TUBES FOR BURNED SCREEN SPOTS.~~	
25. ~~BEFORE STORING OR SHIPPING REMOVE ALL BATTERIES.~~	

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING THE INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. *(Continue on page 4, if more space is needed)*

2 3

TM5544-14 (1)

Figure 12. DA Form 11-266.

MAINTENANCE CHECK LIST FOR SIGNAL EQUIPMENT
TEST EQUIPMENT
(AR 750-625)

EQUIPMENT NOMENCLATURE

RADIO INTERFERENCE MEASURING SET AN/URM-7

EQUIPMENT SERIAL NUMBER

17

INSTRUCTIONS

This form may be used for a period of one month by using the correct dates and weeks of the month. It is to be used as a Preventive Maintenance check list for Signal equipment in actual use, or for a check on equipment prior to issue.

1. For detailed Preventive Maintenance instructions see:
   a. The Technical Manual *(in TM 11 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   b. The Supply Bulletin *(SB 11-100 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   c. The Department of the Army Lubrication Order. *(See DA Pamphlet Number 310-4)*

2. The following action will be taken by either the Communications Officer/ Chief for 1st echelon, or the Inspector for higher echelon
   a. Enter Equipment Nomenclature and Serial Number.
   b. Strike out items that do not apply to the equipment.

3. Operator/Inspector will enter in the columns entitled CONDITION, on the proper line, a notation regarding the condition, using symbols specified under LEGEND.

4. After operator completes each daily inspection he will initial over the appropriate dates under "Daily Condition for Month", then return form to his supervisor.

FOLD

TYPE OF INSPECTION

OPER-ATOR	2/3 ECH-ELON	DATE	SIGNATURE
✓		7 MAY 58	Cpl. C. A. Doe
	✓	9 MAY 58	M/Sgt. D. Black

4

U S GOVERNMENT PRINTING OFFICE 1957 O—427138

DA FORM 1 MAY 57 11-266

Figure 12.—Continued.

34. Visual Inspection

Before operating the equipment, inspect it. Inspection will save repair time and may also avoid further damage. Inspect the following for obvious defects:

a. The seating of all cable connectors.

b. The seating of the tuner in the main unit.

c. The condition of the motor-generator brushes.

d. Connections on terminal boards.

e. Coils and resistors for signs of overheating.

f. Fuses.

35. Tube-Testing Techniques

When trouble occurs, check all cabling, connections, and the battery (if used) before removing any tubes. Try to isolate the trouble to a component or stage. If tube failure is suspected, use the applicable procedure below to check the tubes.

Caution: Do not rock or rotate a tube when removing it from a socket; pull it straight out with a tube puller.

a. Use of Tube Tester. Remove and test one tube at a time. Discard a tube only if its defect is obvious or if the tube tester shows it to be defective. Do not discard a tube that tests at or near its minimum test limit on the tube tester. Put back the original tube, or insert a new one if required, before testing the next one.

b. Tube Substitution Method. Replace a suspected tube with a new tube. If the equipment still does not work, remove the new tube and put back the original tube. Repeat this procedure with each suspected tube until the defective tube is found.

36. Equipment Performance Checklist

a. General. The equipment performance checklist systematically aids in locating trouble in the test set. All corrective measures that can be performed at organizational maintenance levels are given in the corrective measures column. When using the checklist, start at the beginning and follow each step in order. If the corrective measures indicated do not correct the trouble, troubleshooting is required by a higher echelon. Note on the repair tag how the equipment performed and the corrective measures that were taken.

b. Procedure. Place the test set in operation as shown in the checklist below.

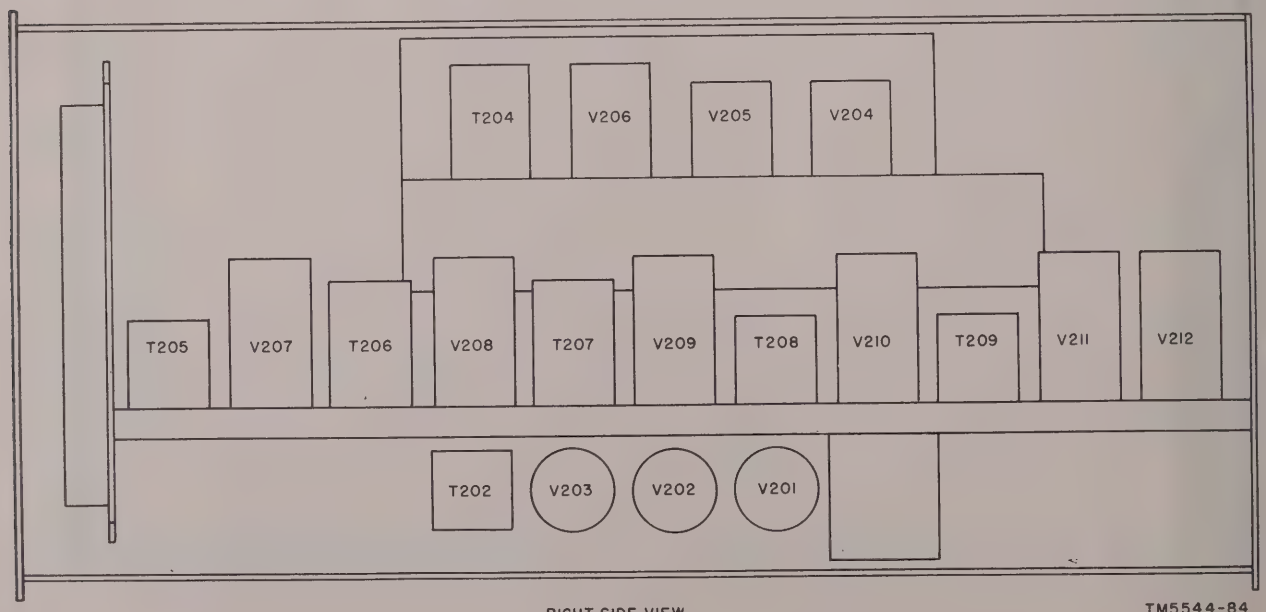


Figure 13. Lf tuner, tube location, right side view, cover removed.

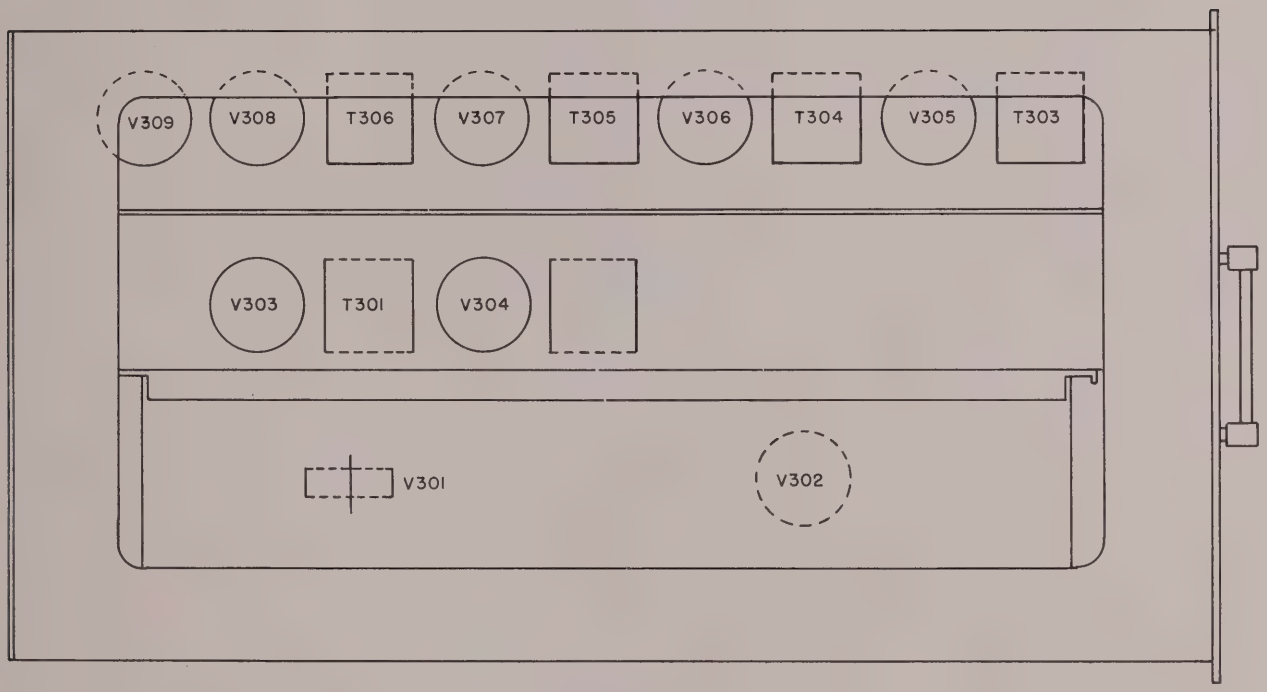


Figure 14. Lf tuner, tube location, left side view, cover removed.

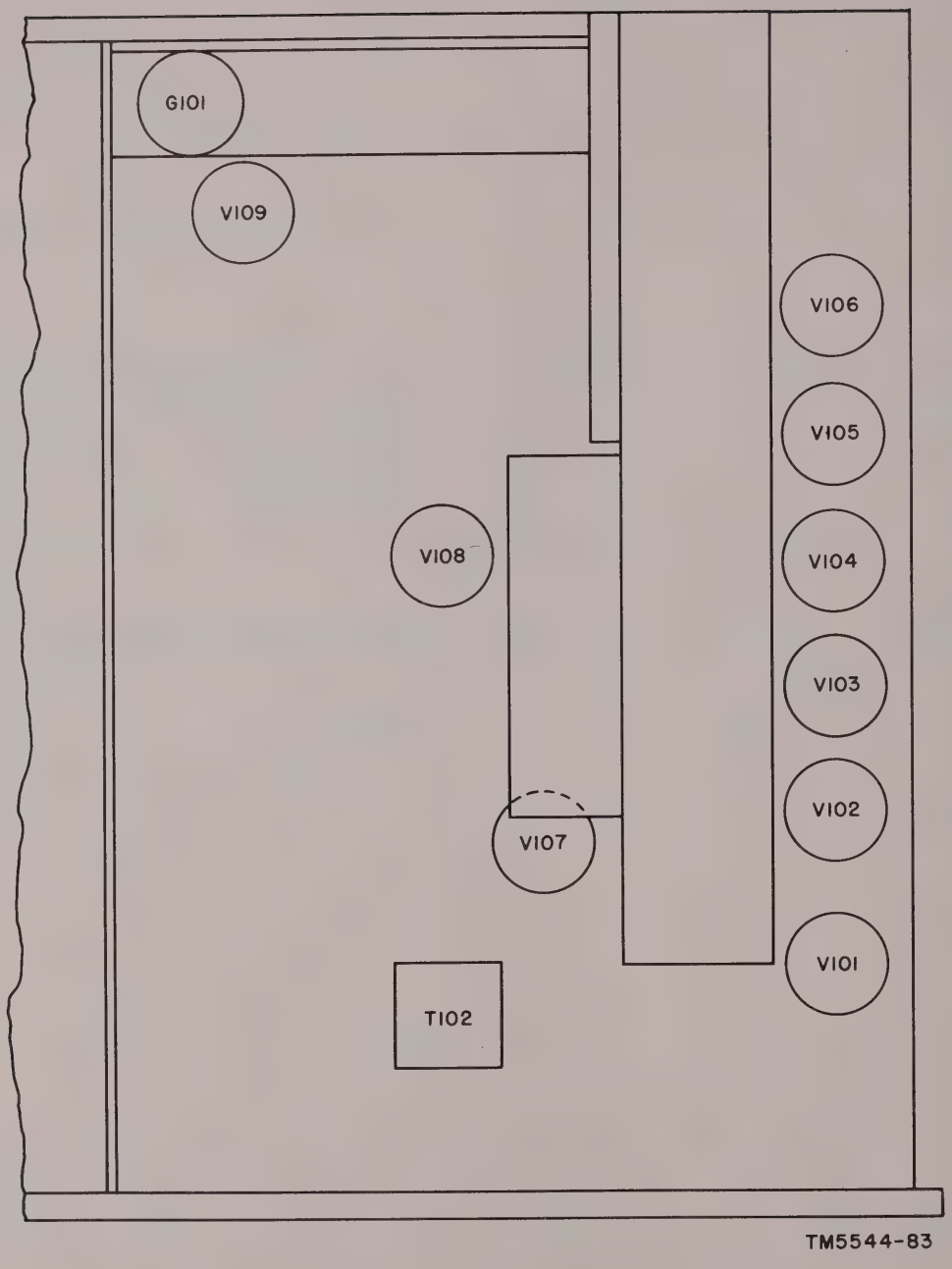


Figure 15. Main unit, tube location, top view.

c. Checklist.

	Step	Unit	Action or condition	Normal indication	Corrective measures
PREPARATORY	1	Main unit	Set power switch at OFF.		
	2	Motor-generator (for dc operation).	Plug battery cable into input receptacle; connect battery clips to 24-volt source. Plug ac power cable into motor-generator and plug other end into POWER receptacle on main unit.		
	3	Transformer (for ac operation other than 115-volt, 50–60 cycles).	Plug cable on transformer into ac source. Plug ac power cable into AC OUTPUT receptacle on transformer and plug other end into POWER receptacle on main unit. Set 115V–230V switch as applicable.		
	4		For 115-volt, 50–60-cycle ac operation, connect the ac power cable between the power source and the POWER receptacle on the main unit.		
	5	Lf tuner	Plug into main unit. Set FREQUENCY RANGE switch at 20–70. Connect the 6-inch RF cable to the 20–70 MC jack and to the ATTEN. OUTPUT jack on the main unit.		
	6	Rf antenna cable	Connect between SIGNAL INPUT jack on main unit and lf antenna.		
	7	Main unit	Set function switch at PULSE PEAK.		
	8	Main unit	Set RF. GAIN control at midposition.		
	9	Main unit	Set IMPULSE GENERATOR switch at OFF.		
	10	Main unit	Set IMPULSE GENERATOR fine output control at 11; set coarse output control at 70.		
	11	Main unit	Set DAMPING switch at OFF.		
	12	Main unit	Turn VOLUME control fully clockwise.		
	13	Main unit	Set SIGNAL INPUT ATTENUATOR at 20.		
	14	Headset	Plug into either PHONES jack on main unit.		
	15	External meter	Plug into EXT METER jack on main unit.		
	16	Main unit	Set CALIBRATION switch at SHUNT.		
START	17	Motor-generator (if used).	Set power switch at ON	Motor-generator runs	Check 15-ampere fuse in motor-generator and replace if necessary. Check input brushes and replace if necessary (par. 37).
		Transformer (if used)	Set power switch at ON.		

	Step	Unit	Action or condition	Normal indication	Corrective measures
START	18	Main unit	Set power switch at ON	Pilot and MEGACYCLES illumination lamps light.	Check lamps and replace if necessary. If transformer or motor-generator is used, check its output voltage with multimeter. Check continuity of ac power cable with multimeter. Check fuse in front panel and replace if necessary. Repeated blowing of fuses indicates another trouble. Tuner not seated firmly. Push tuner all the way in.
				Meters indicate activity	Higher echelon repair required. If panel meter is operative but external meter is not, check continuity of external meter cord. Repair or replace if necessary.
EQUIPMENT PERFORMANCE	19	Main unit	Set function switch at ZERO ADJ. Rotate ZERO ADJ. control.	Meters can be adjusted to 0 μv.	Test tube V108 in main unit and replace if necessary.
	20	Main unit	Set function switch at PULSE PEAK. Set IMPULSE GENERATOR switch at ON.	Noise heard in headset	Check seating of tuner in main unit. Check continuity of 6-inch RF cable. Try other headset. Check all tubes except V108.
				Meters indicate noise level.	Higher echelon repair required.
	21	Main unit	Decrease IMPULSE GENERATOR attenuator coarse and fine output control settings.	Noise decreases in headset. Meter reading decreases.	Higher echelon repair required.
	22	Main unit	Rotate SIGNAL INPUT ATTENUATOR from 0 SUBST to 80.	Noise decreases in headset. Meter reading decreases.	Higher echelon repair required.
	23	Main unit	Set IMPULSE GENERATOR switch at OFF; set CALIBRATION switch at SERIES.	Meter indicates 0 μv	Reset to zero (step 19).
	24	Main unit	Set function switch at CW. AVERAGE.		
	25	Lf tuner	Rotate TUNING control to tune in noise.	Noise heard in headset	Check antenna. Check RF antenna cable. Test all tubes in tuner; replace any found defective (par. 35).
				Meters indicate activity	Test electrometer by substitution.
	26	Main unit	Rotate RF. GAIN control clockwise.	Noise increases in headset.	Higher echelon repair required.
	27	Main unit	Rotate VOLUME control clockwise.	Noise increases in headset.	Higher echelon repair required.
	28	Main unit	Set function switch at CW. PEAK.		

EQUIPMENT PERFORMANCE

Step	Unit	Action or condition	Normal indication	Corrective measures
29	Lf tuner	Rotate TUNING control to tune in cw signal.	Signal heard in headset; meter indicates peak envelope voltage of signal.	Higher echelon repair required.
30	Main unit	Set function switch at METER SLIDEBACK. Rotate SLIDEBACK control so that cw signal is just below audibility.	Cw signal level decreases in volume. Meter indicates voltage required to cut off audio signal.	Higher echelon repair required.
31	Main unit	Set SIGNAL INPUT ATTENUATOR at 0 SUBST. Set function switch at CW. AVERAGE.		
32	Lf tuner	Rotate TUNING control to tune in low level signal.	Meter pointer fluctuates	Higher echelon repair required.
33	Main unit	Set DAMPING switch at ON or MOM.	Meter pointer stops fluctuating.	Higher echelon repair required.
34	Main unit	Set DAMPING switch at OFF.		
35	Lf tuner	Set FREQUENCY RANGE switch at 70–220. Change 6-inch RF cable from 20–70 MC jack to 70–220 MC jack. Repeat steps 19, 20, 25, 26, and 27.		
36	Main unit	Set power switch to OFF.		
37	Lf tuner	Disconnect 6-inch RF cable and pull lf tuner out of main unit.		
38	Hf tuner	Plug into main unit. Connect 6-inch RF cable to jack on front of hf tuner.		
39	Main unit	Set power switch at ON.		
40	Hf antenna	Disconnect RF antenna cable from lf antenna and connect to hf antenna. Repeat steps 19, 20, 25, 26, and 27.		
41	Broadband antenna	Disconnect RF antenna cable from hf antenna and connect to broadband antenna. Repeat steps 19, 20, 25, 26, and 27.		
42	50-ohm coupler	Disconnect RF antenna cable from broadband antenna and connect to 50-ohm coupler. Connect coupler to two-wire line of approximately 50 ohms. Repeat steps 19, 20, 25, 26, and 27.		
43	500-ohm coupler	Disconnect RF antenna cable from 50-ohm coupler and connect to 500-ohm coupler. Connect coupler to two-wire line of approximately 500 ohms. Repeat steps 19, 20, 25, 26, and 27.		
44	Magnetic field probe	Disconnect RF antenna cable from 500-ohm coupler and connect to magnetic field probe. Move field probe near noise source.	Noise heard in headset	Replace magnetic field probe.
45	Electric field probe	Connect electric field probe to RF antenna cable. Move field probe near noise source.	Noise heard in headset	Replace electric field probe.

	Step	Unit	Action or condition	Normal indication	Corrective measures
STOP	46	Motor-generator (if used).	Set power switch at OFF.		
		Transformer (if used)	Set power switch at OFF.		
		Main unit	Set power switch at OFF.		

37. Motor-Generator Brush Replacement

To replace the brushes in the motor-generator—

a. Unlatch the four catches at the sides of the cover and lift off the cover.

b. Remove two binder-head screws at each end of the motor-generator and remove the end bells.

c. Unscrew the brush caps and remove the brushes.

d. Insert the new brushes in the brush holders. Replace the brush caps and the end bells.

CHAPTER 4
THEORY

Section I. GENERAL THEORY OF RADIO INTERFERENCE MEASURING SET AN/URM–7

38. Block Diagram of Test Set (fig. 16)

a. For 115-volt, 60 cycle, ac operation, the main unit is connected directly to the power source. For 115-volt operation, other than 60 cycles, or for 230-volt, 50- to 400-cycle operation, the main unit is connected to Transformer TF–248/G which supplies the required power when it is connected to the power source. For 24-volt dc operation, Motor-Generator PU–388/G converts the dc input to ac power.

b. In one method of measuring the interference generated by a piece of electronic equipment, the interference signal is fed through the main unit and tuner and the signal level is indicated on a front panel meter. The output of an impulse generator in the main unit is also fed through the tuner and varied in amplitude to give the same indication on the meter. Because the output of the impulse generator is calibrated, the interference signal can be calculated. As an alternate method, the impulse generator output is used to calibrate a front panel meter in microvolts. The interference signal is then read directly on the meter.

c. In both of the methods outlined in *b* above, shunt calibration is employed; that is, the calibrating voltage is applied at the same input receptacle that is used for the interference signal.

d. When the broadband antenna is used, series calibration is employed. In this method, the calibrating voltage is injected at the antenna in series with the signal being measured.

e. Interference field strength and carrier field strength measurements are made using the two methods described in *b* above, except that a dipole antenna coefficient must be included in the calculation.

(1) The interference signal or impulse generator output is picked up by one of the antennas, couplers, or probes (depending on the type of measurement being made) and is fed to the tuner where it is amplified and fed back to the main unit as a dc voltage that activates the meter.

(2) The signal is also detected in the tuner and fed back to the main unit as an AF voltage. This AF voltage is amplified in the main unit and gives an aural indication of the signal when a headset is plugged into the main unit.

f. The low-frequency or high-frequency tuner is used to amplify the RF voltage from the signal under measurement. Attenuation of the signal is introduced in certain sections so that the total attenuation in the test set is the same as the attenuation marked on the front panel. Each tuner contains an electrometer detector unit which gives a dc output equal to either the peak or the average if output.

39. Types of Measurements

a. Conducted Noise Measurements. The 50-ohm coupler is used when the impedance of the equipment or line being measured is approximately 50 ohms. The 500-ohm coupler is used when the impedance of the equipment or line being measured is approximately 500 ohms. The coupler matches the impedance of the equipment being measured to the RF antenna cable.

b. Noise Measurements. The lf antenna is used to make noise measurements between 20 and 200 mc. The hf antenna is used to make noise measurements between 200 and 400 mc. The broadband antenna can also be used to make noise measurements between 20 and 400 mc. The unbalanced injection block is used to match the impedance of the broadband antenna to the RF antenna cable.

c. Carrier Field Intensity. Use of the lf or hf antenna depends on whether the frequency being measured is below or above 200 mc.

d. Localization of Noise. The magnetic field probe and electrical field probe are used to pinpoint noise generated by equipment.

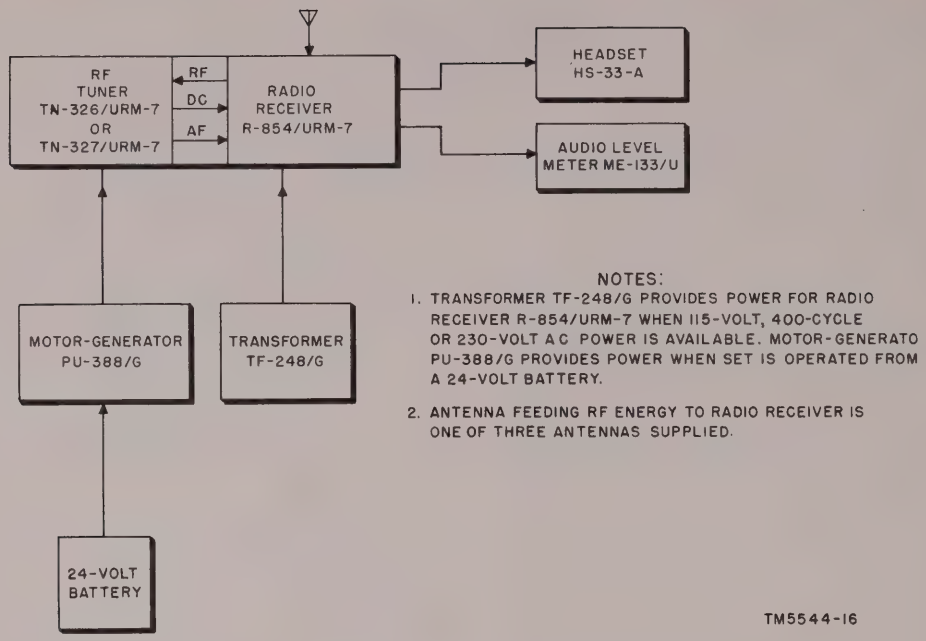

RF TUNER TN-326/URM-7 OR TN-327/URM-7
RF
DC
AF
RADIO RECEIVER R-854/URM-7
HEADSET HS-33-A
AUDIO LEVEL METER ME-133/U
MOTOR-GENERATOR PU-388/G
TRANSFORMER TF-248/G
24-VOLT BATTERY
NOTES:
1. TRANSFORMER TF-248/G PROVIDES POWER FOR RADIO RECEIVER R-854/URM-7 WHEN 115-VOLT, 400-CYCLE OR 230-VOLT A C POWER IS AVAILABLE. MOTOR-GENERATO PU-388/G PROVIDES POWER WHEN SET IS OPERATED FROM A 24-VOLT BATTERY.
2. ANTENNA FEEDING RF ENERGY TO RADIO RECEIVER IS ONE OF THREE ANTENNAS SUPPLIED.
TM5544-16

Figure 16. Radio Interference Measuring Set AN/URM–7, block diagram.

Section II. THEORY OF RADIO RECEIVER R–854/URM–7

40. Block Diagram of Main Unit

The block diagram for the main unit is shown in figure 17. For complete circuit details, refer to figure 57. Individual stages are described in paragraphs 41 through 49.

a. Audio Amplifiers. The first and second audio amplifiers, V107, amplify the audio signal from the tuner in use. The output of the second audio amplifier is applied to the PHONES jack on the front panel.

b. Detector and Meter Stage. Detector and meter stage V108 receives a dc voltage from the tuner that is proportional to the received signal level fed into the tuner. It serves in a vacuum tube voltmeter circuit that operates the front-panel and external indicating meters.

c. Indicating Meters. The meters are calibrated by the impulse generator output so that unknown signal levels can be read directly. The unknown signal is used to give a reference reading on the meters. The calibrated impulse generator output is compared to the unknown signal which can then be calculated.

d. Repetition Rate Generator. Repetition rate generator V109B is an rc type oscillator which generates a basic repetition rate of approximately 70 cycles per second (cps). Its output is used to operate a delay line that generates the frequency spectrum.

e. Impulse Generator Driver. Impulse Generator Driver V109A increases the amplitude of the pulses from the repetition rate generator. The output is fed to the impulse generator.

f. Impulse Generator. The impulse generator produces a broadband signal whose frequency spectrum is flat from 150 kc to 1,000 mc. This is produced by the transient discharge of a dc voltage on a length of coaxial line into a 50-ohm terminating resistor. A mercury switch operated by the impulse generator driver opens and closes the coaxial circuit. Two attenuators, part of the impulse generator circuit, control the dc charging voltage on the coaxial line.

g. Coaxial Relay K102. Coaxial relay K102 couples the output of the impulse generator to the IMPULSE OUTPUT jack or to attenuator AT103. With this 20-db attenuator in the circuit, the impulse generator output agrees with the attenuation readings on the front panel.

h. Attenuator AT103. Attenuator AT103 is a fixed, 20-db attenuator over the frequency

range of the equipment. It attenuates the signal from the impulse generator and feeds it to the coaxial relay.

i. Coaxial Relay K103. Coaxial relay K103 connects either the impulse generator signal from attenuator AT103 or the unknown signal from the SIGNAL INPUT receptacle to step attenuator AT104.

j. Step Attenuator AT104. Step attenuator AT104 is flat over the frequency range of the equipment. It attenuates all signals fed to the receiver, so that an on-scale reading can be obtained on the meters for both weak and strong signals.

k. Power Supply. The power supply provides regulated plate voltage and filament voltage for the main unit, regulated —150 volts for the meter circuit, and all voltages for the tuners. The input voltage to the power supply is controlled by a vibrating-type voltage regulator in the input line.

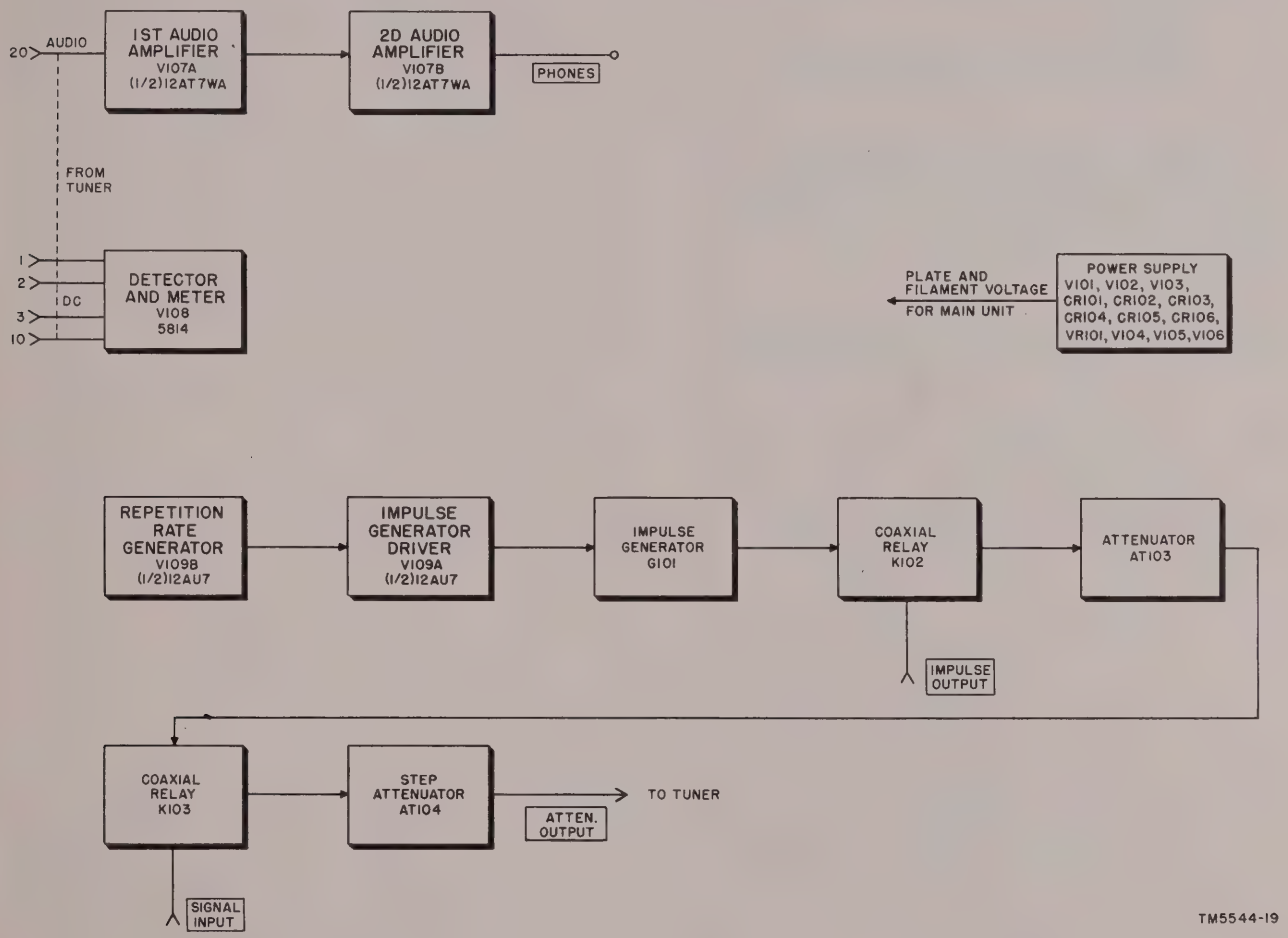


Figure 17. Radio Receiver R–854/URM–7, block diagram.

41. First Audio Amplifier V107A (fig. 18)

Audio frequency voltage from the radio receiver is applied to first audio amplifier V107A. The audio voltage is amplified and fed to second audio amplifier V107B.

a. The AF voltage at terminal 20 of connector J102 is applied to VOLUME control R131 through a filter network consisting of C112, C113, C114, R128, R129, and R130. The filter network eliminates any RF signal present in the audio circuits. According to the position of the arm of the VOLUME control, all or part of the AF voltage is applied to the control grid (pin 2) of V107A.

b. Resistor R130 is the SLIDE BACK con-

trol. It places a negative bias on the plate of the diode detector in the tuner so that only signals above the set level will be heard in the headset.

c. Cathode bias is provided by the voltage drop across R132, which is bypassed by C115.

d. Resistor R133 is the plate load resistor. Resistor R134 and capacitor C116 form a plate circuit decoupling network.

e. The amplified AF voltage in the plate circuit is coupled to second audio amplifier V107B by capacitor C117.

42. Second Audio Amplifier V107B (fig. 18)

a. The amplified AF voltage from the plate of V107A is applied to the control grid (pin 7) of V107B. Capacitors C117 and C118 act as an input voltage divider. R135 is the grid return resistor.

b. Cathode bias is provided by the voltage drop across R136, which is bypassed by C119.

c. Plate voltage is applied through the primary of T102. The amplified AF voltage in the plate circuit appearing across the primary of T102 is coupled to the secondary and fed through an audio filter consisting of capacitor C120 and choke L102 to the PHONES jacks. The audio filter prevents external signals from entering the equipment through the phone lead.

43. Cathode Follower and Meter Stage V108 (fig. 19)

Section A of V108 receives the full output voltage from the electrometer detector unit in the tuner (par. 62). This section acts as a cathode follower and the output is applied to the plus side of the meter. Section B of V108 receives one-half of the output voltage from the electrometer detector unit in the tuner. This section also acts as a cathode follower, and the output is applied to the minus side of the meter. Since the voltages are subtracted, the meter reads one-half of the output from the electrometer detector unit in the tuner.

a. Resistors R148 and R149 are the cathode resistors for V108A. Resistors R150 and R151 are the cathode resistors for V108B.

b. Resistors R147 and R152 are the grid return resistors for V108A and V108B, respectively.

c. Resistors R141, R142, and R153 are meter multiplier resistors.

d. Capacitor C121 damps the meter movement when DAMPING switch S104 is at the ON or MOM. position. The switch is used at

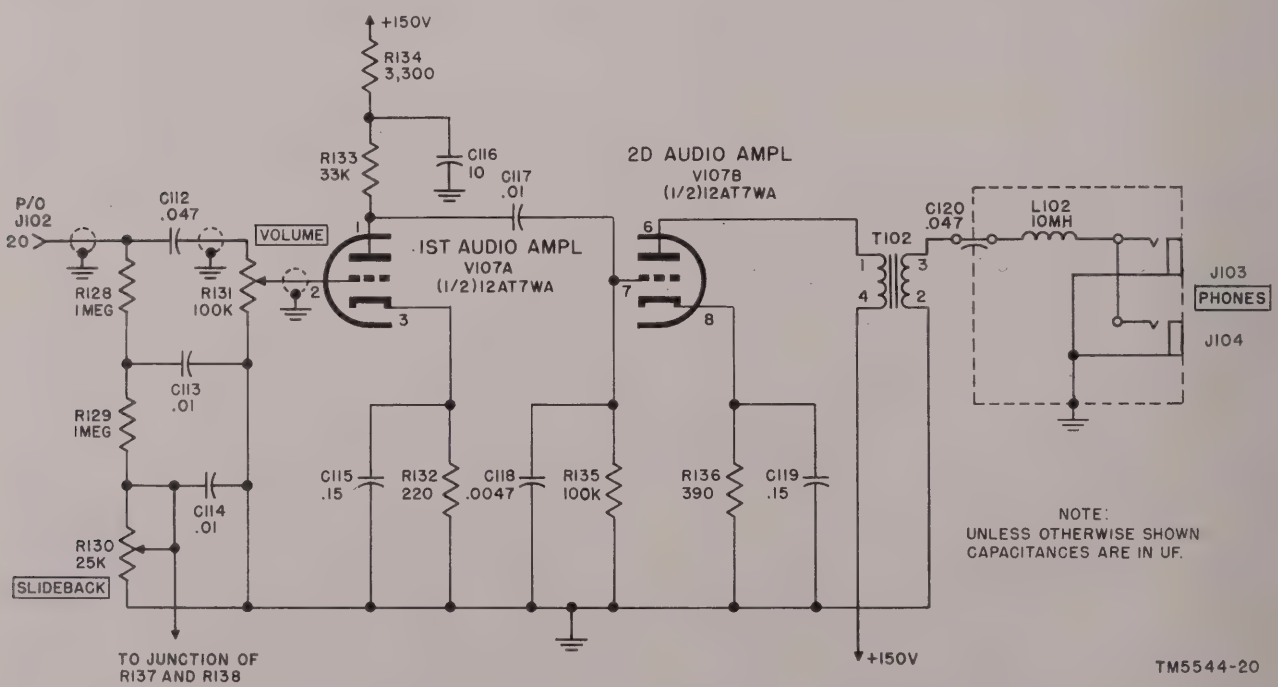


Figure 18. First and second audio amplifiers, schematic diagram.

low signal levels when the noise signal causes the meter needle to fluctuate.

e. When switch S111 is opened, resistor R140 is placed in series with the meter. This allows cathode follower alinement in the tuner without driving the meter off scale.

f. In the CW. AVERAGE position of switch S106, 6.3 volts is applied to the thermal switches in the electrometer detector unit of the tuner (par. 62) through section 3 of the switch. This changes the detector load from 20,000 megohms to ½ megohm, which causes the detector output to be average envelope voltage instead of peak. Therefore the meter reads average envelope voltage.

g. In the CW. PEAK position of function switch S106, the detector load in the electrometer (par. 62) is 20,000 megohms; this gives the circuit a very long time constant. The circuit charges to peak envelope voltage and does not discharge because of the long time constant. This is the output voltage which is indicated on the meter.

h. In the 0 CW ONLY position, SIGNAL INPUT ATTENUATOR AT104 introduces 10 db of attenuation in the circuit. This is balanced by shorting out resistor R157 which takes 10 db of attenuation out of the circuit so that effectively the attenuation is still at 0 db.

i. In the ZERO ADJ position of the function switch, the IF amplifier is disabled by being biased beyond cutoff. The two halves of V108 are balanced with ZERO ADJ control R151.

j. In PULSE PEAK position, meter multiplier resistors R141 and R142 are placed in series with the meter so that the meter is 6 db less sensitive than the CW. PEAK position. This is required because of the design of the IF amplifier.

k. In the METER SLIDEBACK position of the function switch, the negative dc voltage necessary to back-bias the audio detector to zero audio signal is measured in the meter circuit.

l. EXT METER jack J105 is housed in a shielded box. With no plug in the jack, resistor

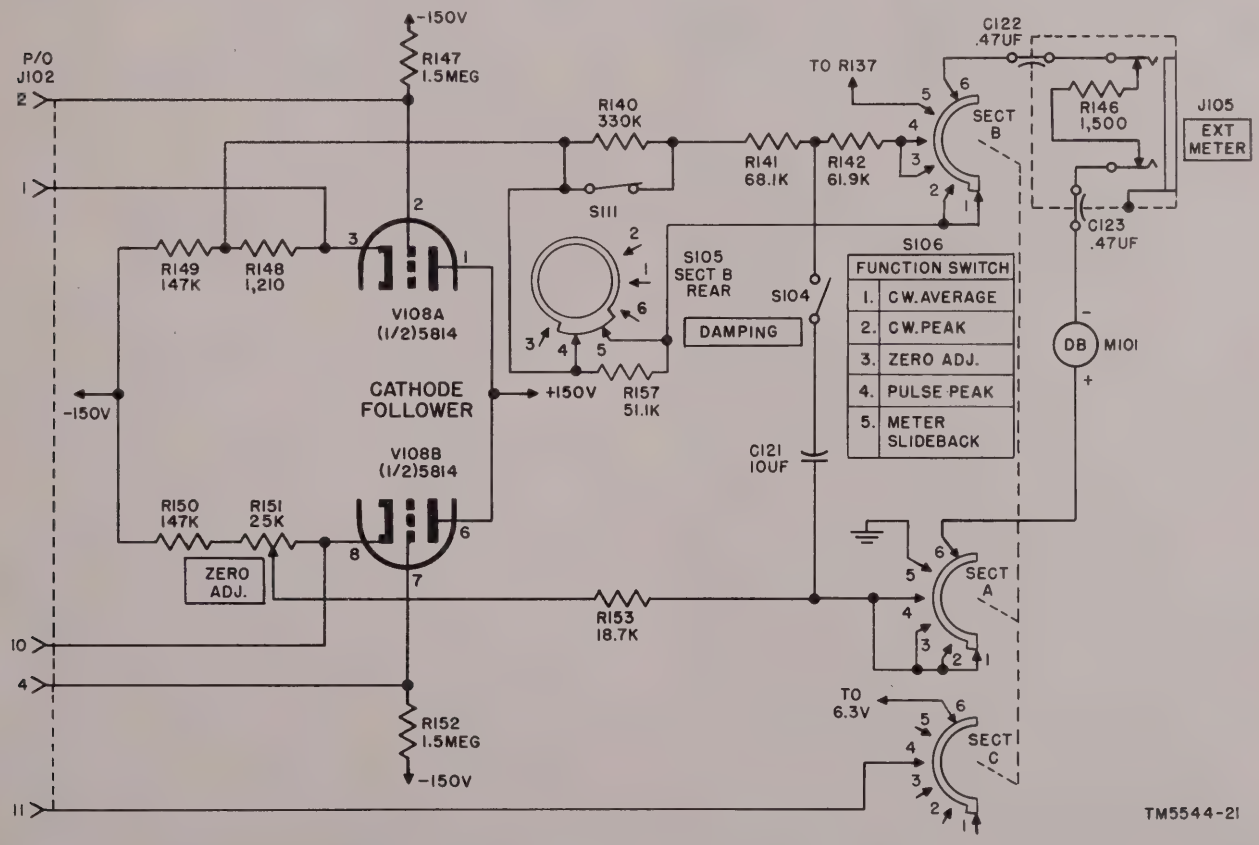


Figure 19. Cathode follower and meter stage, schematic diagram.

R146 is in series with meter M101. When the external meter cord is plugged into the jack, the external meter is placed in series with the panel meter and resistor R146 is taken out of the circuit. Capacitors C122 and C123 filter RF noise from the external meter cord.

44. Function Switch Operation

The following subparagraphs give the circuit conditions for each position of the function switch.

a. CW. AVERAGE. The output of V108A goes through section B of the switch, J105 and its filter, to the negative side of M101. The output of V108B goes through resistor R153 and section A of the switch to the positive side of M101. A voltage of 6.3 volts ac is fed through section C of the switch and terminal 11 of J102 to the electrometer detector unit and applied to switches V402 and V403 which close. Resistors R404 and R405 are shunted by R406 and R407 so that the electrometer measures average envelope voltage.

b. CW. PEAK. The circuits are the same as the CW. AVERAGE position, except that 6.3 volts ac is not applied to switches V402 and V403, which remain open so that the electrometer measures peak envelope voltage.

c. ZERO ADJ. A voltage of —150 volts is applied through resistor R143 and terminal 18 of J102 to the grid of the IF amplifier in the tuner, biasing the amplifier below cutoff. The meter can be zeroed with no signal from the tuner to unbalance the circuit. The output of V108A goes through resistors R140, R141, and R142, section B of the switch, and J105 and its filter to the negative side of M101. The output of V108B is the same as that given in *a* above.

d. PULSE PEAK. The output of V108A is the same as that given in *c* above. The output of V108B is the same as that given in *a* above. A voltage of —150 volts is applied through section D of the switch and resistor R138 to SLIDE BACK control R130. This places a negative bias on the plate of the audio detector so that only AF signals larger than the set level will be heard in the headset.

e. METER SLIDEBACK. The negative voltage on SLIDE BACK control R130 goes through resistor R137, section B of the switch, J105 filter, to the negative side of M101. The positive side of M101 is grounded through section A of the switch. The level of signal is the negative voltage required to set the signal at the threshold of audibility and is indicated on the meter.

45. Repetition Rate Generator V109B (fig. 20)

Repetition rate generator V109B is a phase-shift oscillator that generates a basic frequency of approximately 70 cps. The output signal is used to drive the impulse generator.

a. Resistors R164, R165, R166, and capacitors C127, C128, and C129 are the frequency-determining components.

b. Resistor R163 is the grid return resistor. Resistor R162 is the cathode resistor.

c. Plate voltage is applied through plate load resistor R159.

d. Feedback from the plate to the frequency determining circuit in the grid circuit is made through coupling capacitor C130.

e. The oscillations generated in the stage are coupled to impulse generator driver V109A through coupling capacitor C126.

46. Impulse Generator Driver V109A (fig. 20)

Stage V109A develops a voltage that operates the impulse generator.

a. The 70-cps voltage from V109B is applied to the control grid (pin 7) of V109A.

b. Resistor R161 is the grid return resistor.

c. Cathode bias is provided by the voltage drop across cathode resistor R160.

d. B+ voltage is applied to the plate through voltage dropping resistor R158 and the coil of the impulse generator. Capacitor C125 provides power-supply decoupling.

e. Capacitor C124 and the impulse generator coil form the plate load. The coil operates the mercury switch which helps to generate the noise pulses by discharging the coaxial line.

47. Impulse Generator (fig. 20)

The coaxial delay line charges up according to the position of attenuators AT101 and AT 102. The coil surrounding the mercury switch is part of the plate load of impulse generator driver V109A. The 70-cps voltage across the

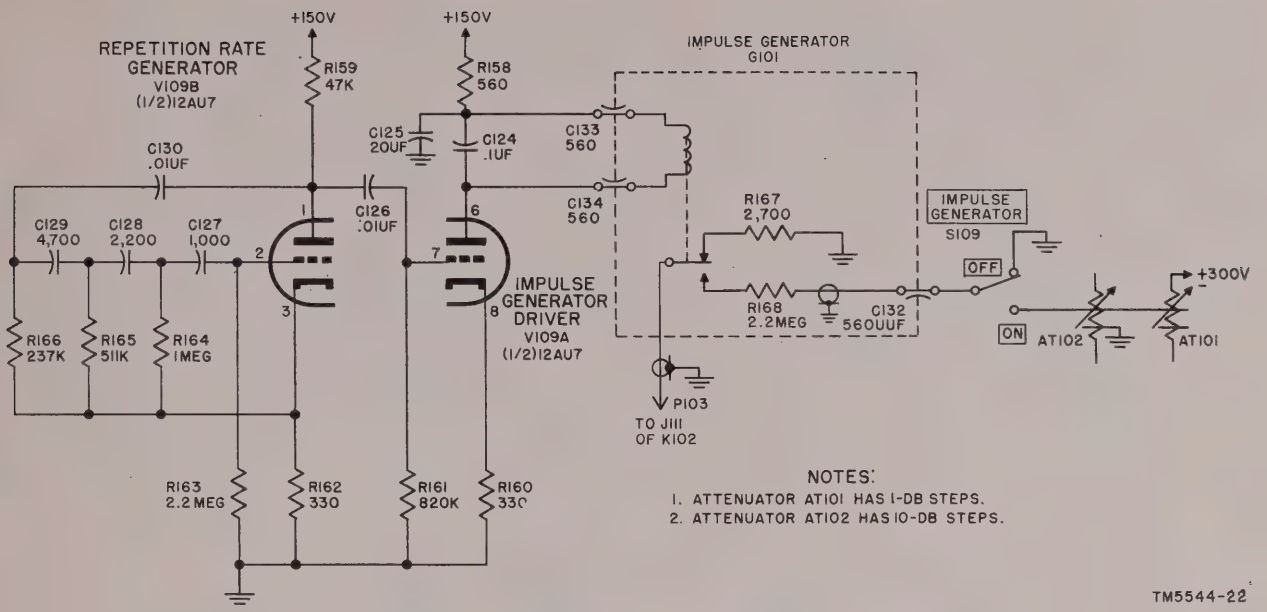


Figure 20. Repetition rate generator and impulse generator driver, schematic diagram.

coil operates the switch. The transient discharge of the dc voltage on the delay line produces a broadband signal whose frequency spectrum is flat from 125 kc to 1,000 mc.

a. Resistor R167 discharges any current on the coaxial line connected to the switch arm. Resistor R168 limits the current on the coaxial line.

b. Capacitors C132, C133, and C134 filter the leads in and out of the impulse generator can.

c. The impulse generator output is fed to coaxial relay switch K102 through plug P103.

48. Coaxial Relays and Attenuators
(fig. 21)

a. When CALIBRATION switch S110 is in the SERIES position, the broadband signal is fed to IMPULSE OUTPUT jack J106.

b. When CALIBRATION switch S110 is in the SHUNT position, the noise signal is fed through 20-db attenuator AT103 to coaxial relay K103. Attenuator AT103 attenuates the impulse generator output so that the attenuated output agrees with the markings on the front panel. From K103 the noise signal is connected to SIGNAL INPUT ATTENUATOR AT104.

c. The signal is attenuated between 0 and 80 db, depending on the setting of attenuator AT 104, and connected to ATTENUATOR OUTPUT jack J108. Attenuator AT104 has a maximum attenuation of 60 db. Twenty-db attenuation is introduced in the tuner; this gives a total of 80 db.

d. When CALIBRATION switch S110 is in the SERIES position, an external signal connected to SIGNAL INPUT jack J107 is fed through coaxial relay K103 to attenuator AT104 and out to ATTENUATOR OUTPUT jack J108. Twenty db of attenuation taken out of the circuit by AT103 is replaced by 20 db of attenuation in the unbalanced injection block.

49. Power Supply
(fig. 22)

The power supply provides all the power requirements for the circuits in the main unit and the tuner. The input voltage is controlled by a voltage regulator. Two of the output voltages are controlled by voltage regulator tubes.

a. AC voltage is connected to the main unit at POWER receptacle J101. The voltage is fed through filter FL101 and ON-OFF switch S103 at the ON position. One side of the line goes through fuse F101, the primary of transformer T101, interlock switch S102, and filter FL103 to the voltage regulator. The second side of the line goes through filter FL102 to the voltage regulator. Filters FL102 and FL103 prevent interference from relay contact arcing in the voltage regulator.

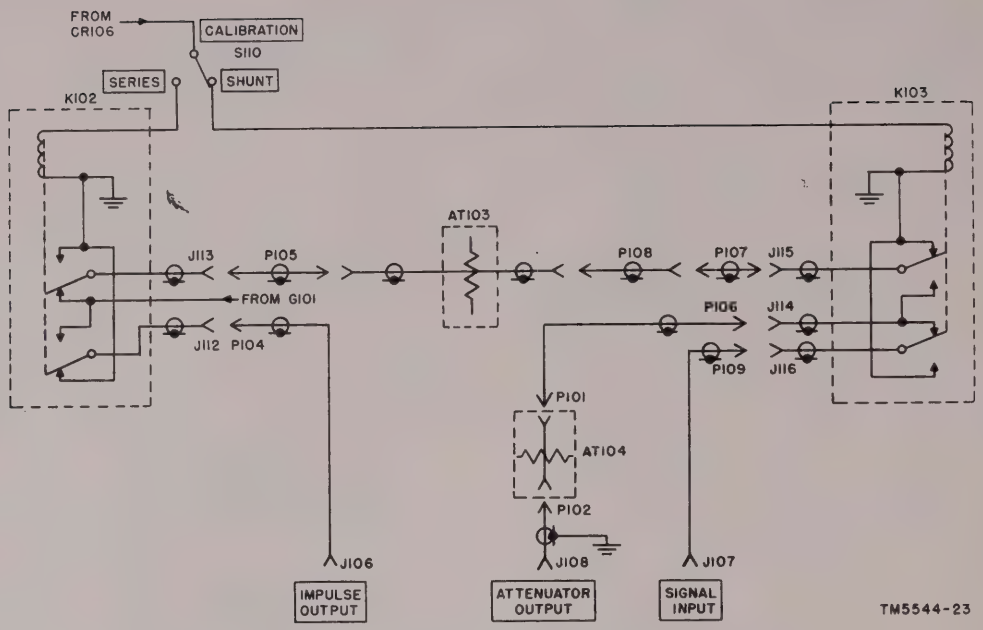


Figure 21. Coaxial relays and attenuators, simplified schematic diagram.

b. The voltage regulator consists of a relay with a lever arm that controls the resistance in series with the input line. If the input voltage goes up, the rectified output current through the relay coil goes up, increasing the magnetic field strength. This increases the pull on the lever arm, shorting parallel resistors out of the circuit. The series resistance increases and causes the input voltage to go down. If the input voltage goes down, the reverse action takes place.

c. Resistors R116 through R125 are in parallel and in series with the input line. Capacitor C109 acts as a filter across the line. Relay K101 controls the amount of resistance in the circuit. Filter FL104 bypasses all RF noise generated in the voltage regulator. REGOHM ADJUST control R127 sets the operating point of relay K101. Resistor R162 decreases the resistance in series with the relay coil to provide the proper amount of dc current through the coil.

d. One secondary winding of transformer T101 (terminals 9 and 10) provides heater current for all tubes in the tuner except V212.

e. One secondary winding (terminals 13 and 14) provides heater current for V212 in the tuner.

f. One secondary winding (terminals 15, 16, and 17) steps up the input voltage to 450 volts. Rectifier tubes V101 and V102 in a full-wave circuit rectify the stepped up voltage. Resistors R102 and R103 are voltage dropping resistors. The fluctuating dc voltage is smoothed by a choke-input filter consisting of sections A and B of choke L101 and sections A and B of capacitor C101. The +150-volt filtered output is connected to terminal 17 of J102.

g. One half of the secondary, used as described in *f* above, is connected to the cathode of half-wave rectifier V103. The negative output is filtered by resistors R104 and R105 and capacitors C102 and C103. Resistor R106 is the voltage dropping resistor in series with regulator V104 which holds the output at —150 volts.

h. One secondary winding (terminals 11 and 12) steps up the input voltage to 560 volts. The voltage is rectified by a half-wave metallic-type rectifier CR101. The rectifier output is filtered by resistors R107 and the two sections of capacitor C104. Resistor R108 is the voltage dropping resistor in series with regulators V105 and V106 in series which hold the output at 300 volts. Resistor R109 is a voltage dropping resistor. The output can be made positive or negative according to the position of switch S101.

(1) The high side of variable resistor R111 is connected to the +150-volt

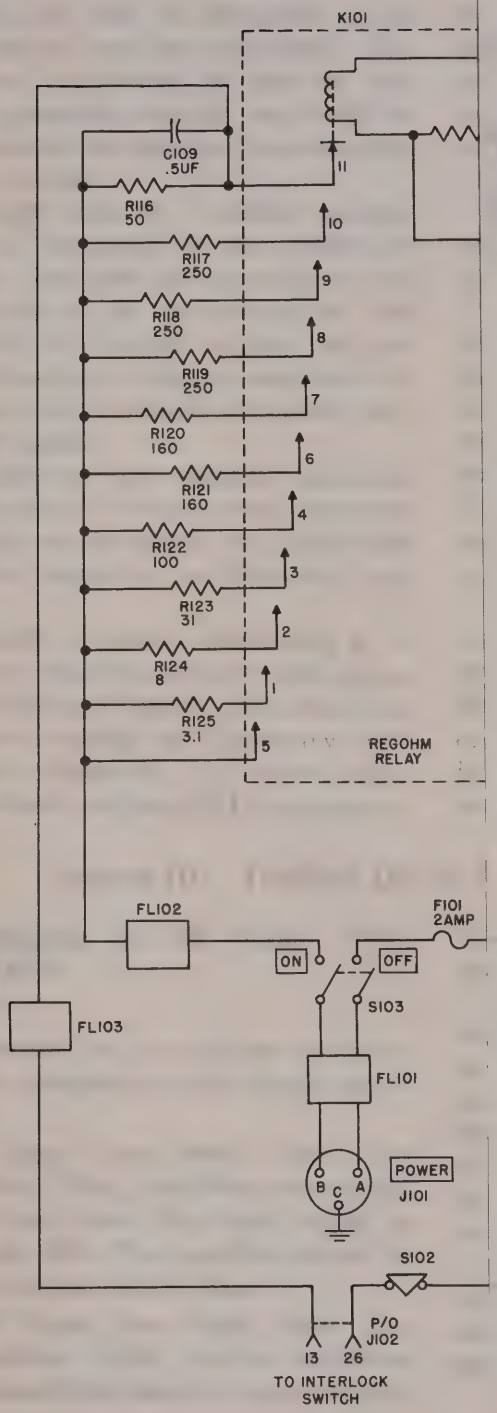


Figure 22. Power supply, schemat

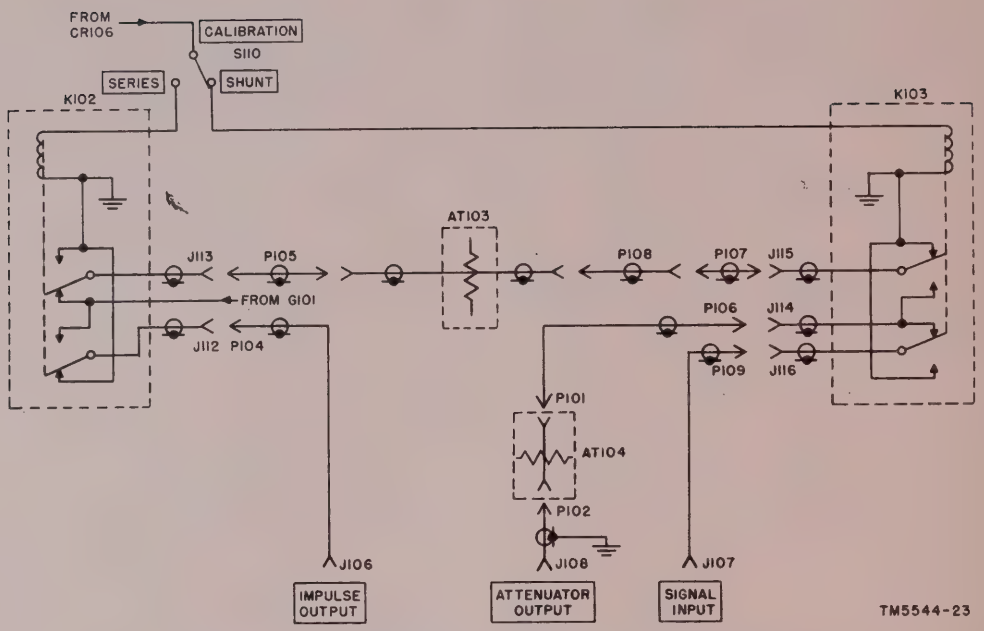


Figure 21. Coaxial relays and attenuators, simplified schematic diagram.

b. The voltage regulator consists of a relay with a lever arm that controls the resistance in series with the input line. If the input voltage goes up, the rectified output current through the relay coil goes up, increasing the magnetic field strength. This increases the pull on the lever arm, shorting parallel resistors out of the circuit. The series resistance increases and causes the input voltage to go down. If the input voltage goes down, the reverse action takes place.

c. Resistors R116 through R125 are in parallel and in series with the input line. Capacitor C109 acts as a filter across the line. Relay K101 controls the amount of resistance in the circuit. Filter FL104 bypasses all RF noise generated in the voltage regulator. REGOHM ADJUST control R127 sets the operating point of relay K101. Resistor R162 decreases the resistance in series with the relay coil to provide the proper amount of dc current through the coil.

d. One secondary winding of transformer T101 (terminals 9 and 10) provides heater current for all tubes in the tuner except V212.

e. One secondary winding (terminals 13 and 14) provides heater current for V212 in the tuner.

f. One secondary winding (terminals 15, 16, and 17) steps up the input voltage to 450 volts. Rectifier tubes V101 and V102 in a full-wave circuit rectify the stepped up voltage. Resistors R102 and R103 are voltage dropping resistors. The fluctuating dc voltage is smoothed by a choke-input filter consisting of sections A and B of choke L101 and sections A and B of capacitor C101. The +150-volt filtered output is connected to terminal 17 of J102.

g. One half of the secondary, used as described in *f* above, is connected to the cathode of half-wave rectifier V103. The negative output is filtered by resistors R104 and R105 and capacitors C102 and C103. Resistor R106 is the voltage dropping resistor in series with regulator V104 which holds the output at —150 volts.

h. One secondary winding (terminals 11 and 12) steps up the input voltage to 560 volts. The voltage is rectified by a half-wave metallic-type rectifier CR101. The rectifier output is filtered by resistors R107 and the two sections of capacitor C104. Resistor R108 is the voltage dropping resistor in series with regulators V105 and V106 in series which hold the output at 300 volts. Resistor R109 is a voltage dropping resistor. The output can be made positive or negative according to the position of switch S101.

(1) The high side of variable resistor R111 is connected to the +150-volt

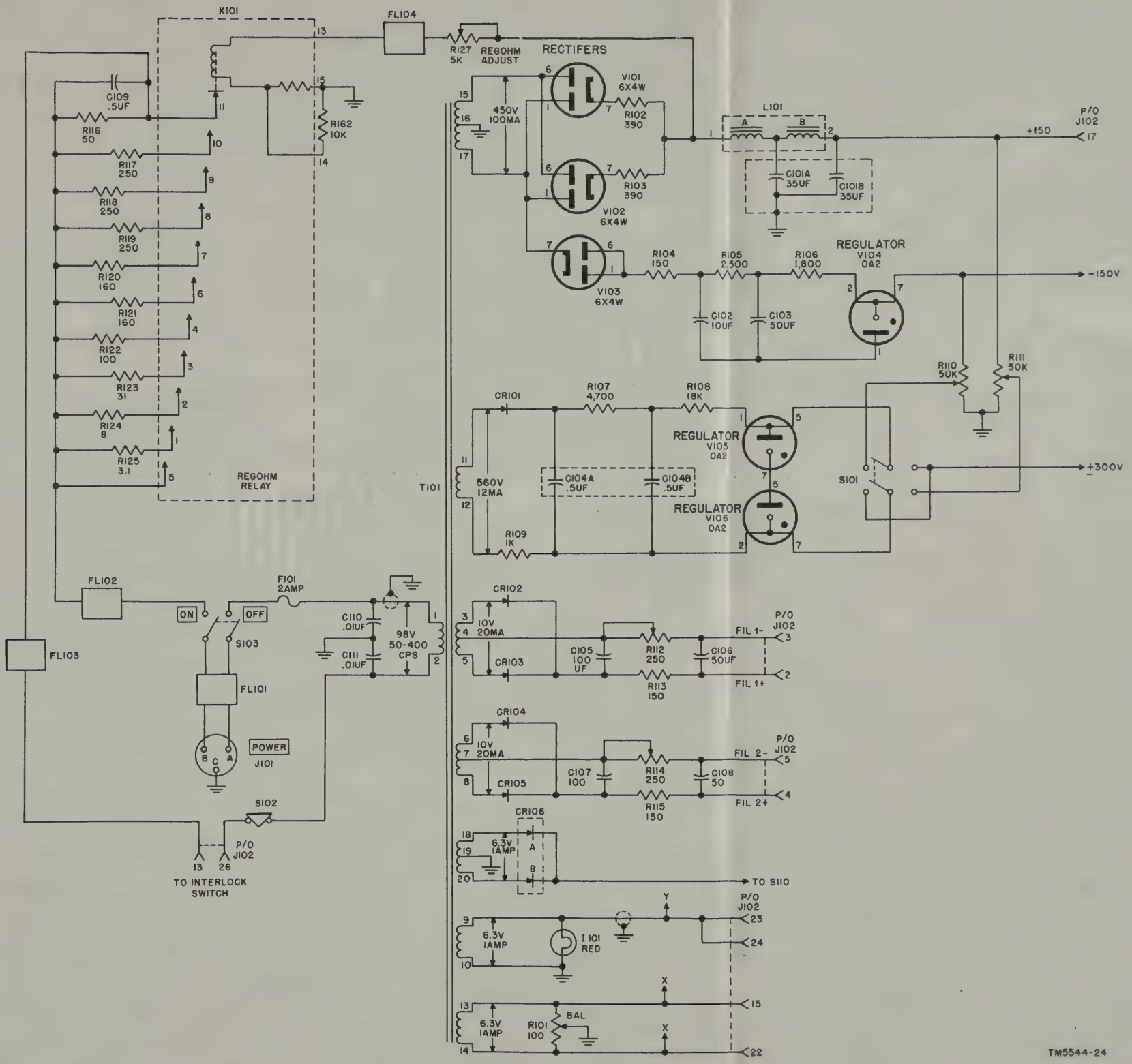
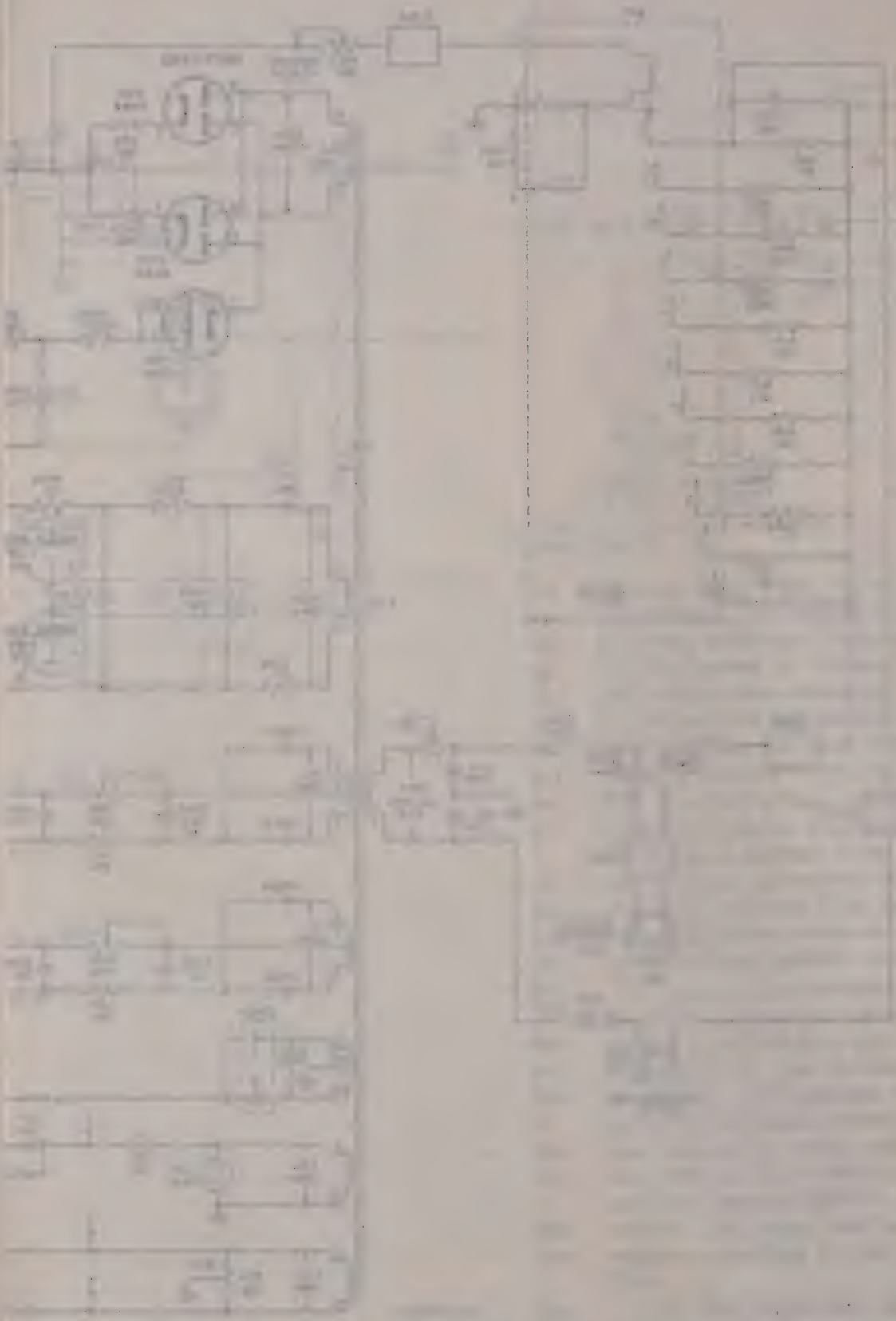


Figure 22. Power supply, schematic diagram.



supply. The arm is connected to the plus side of the 300-volt output. The resistor is adjusted so that the impulse generator output amplitude is the same as the standard impulse generator output.

(2) The high side of variable resistor R110 is connected to the —150-volt supply. The arm is connected to the minus side of the 300-volt output. The resistor is adjusted so that the impulse generator output amplitude is the same as the standard impulse generator output.

(3) The positive and negative positions are provided for use by test engineers in analyzing the effects of positive and negative impulses on electronic systems.

i. One secondary winding (terminals 3, 4, and 5) steps down the voltage to 10 volts. Crystal rectifiers CR102 and CR103, connected as a full-wave rectifier, rectify the secondary voltage. The output is filtered by a pi-section filter, consisting of variable resistor R112 and capacitors C105 and C106. Resistor R112 adjusts the dc output to 1.25 volts which is connected to pins 2 and 3 of J102. This supplies heater power for V404 of the electrometer detector unit in the tuner (par. 62). Resistor R113 is a voltage dropping resistor.

j. One secondary winding (terminals 6, 7, and 8) performs the same function as that described in *i* above. Crystal rectifiers CR104 and CR105, connected as a full-wave rectifier, rectify the secondary voltage. The output is filtered by a pi-section filter consisting of variable resistor R114 and capacitors C107 and C108. Resistor R114 adjusts the dc output to 1.25 volts which is connected to pins 4 and 5 of J102. This supplies heater power for V405 of the electrometer detector unit in the tuner. Resistor R115 is a voltage dropping resistor.

k. One secondary winding (terminals 18, 19, and 20) steps down the voltage to 6.3 volts. The voltage is rectified by metallic rectifier CR106, a full-wave rectifier. This voltage is connected to CALIBRATION switch S110 and is used to energize the coaxial relays in the main unit.

Section III. THEORY OF RF TUNER TN–326/URM–7

50. Block Diagram of RF Tuner TN–326/URM–7

(fig. 23)

The block diagram for the lf tuner is shown in figure 23. For complete circuit details, refer to figure 55.

a. First RF Stage, Low Band, V201. The first RF amplifier, V201, amplifies the signal from the main unit when the input signal is connected to jack J201. The amplified signal is then coupled to the second RF stage.

b. Second RF Stage, Low Band, V202. The second RF amplifier, V202, further amplifies the signal. The amplified signal is then coupled to the mixer stage.

c. Oscillator, V203B. Oscillator V203B generates a signal which is 10.7 mc higher than the corresponding RF frequency. This signal is coupled to mixer stage V203A.

d. Mixer, V203A. The signals from the second RF amplifier, V202, and the local oscillator V203B are combined in the mixer stage. The difference frequency is coupled to the first IF stage V207, through relays K201 and K202.

e. 70- to 220-MC Section. The 70- to 220-mc section is essentially the same as the 20- to 70-mc section of the lf tuner. Corresponding parts in each stage perform the same function. The four IF amplifiers, V207 through V210, provide additional signal gain and selectivity and are fixed tuned to the 10-7-mc signal from the mixer stage.

f. Cathode Follower Stage V211. Cathode follower V211 is used to obtain a low-impedance source to feed the electrometer detector unit and audio detector V212.

g. Electrometer Detector Unit. The electrometer presents a very high impedance to the signal, so that no loss is introduced when the signal is coupled from the cathode follower. The peak average envelope voltage is fed to cathode follower V108 in the main unit.

h. Detector Stage V212. Detector stage V212 demodulates the audio signal and feeds it to audio amplifier V101 in the main unit.

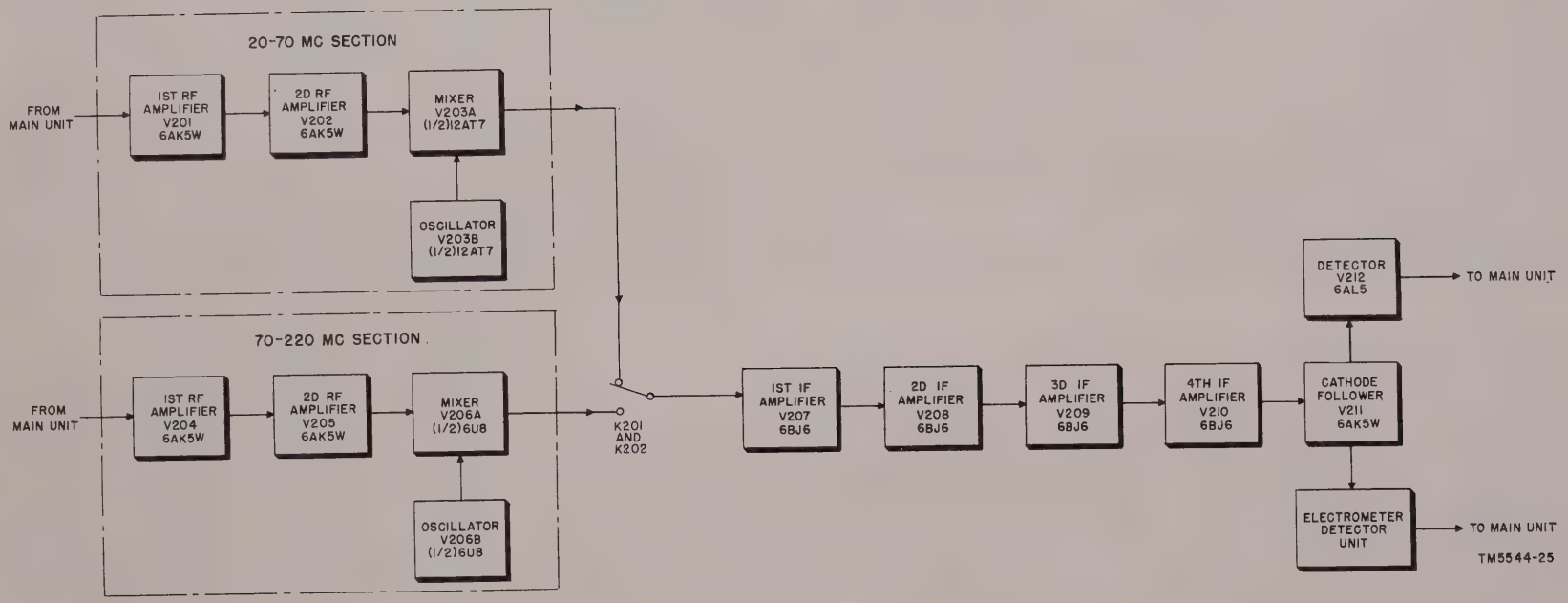


Figure 23. Lf tuner, block diagram.

51. First Low-Band RF Amplifier, V201 (fig. 24)

When 20–70 MC jack J201 is connected to the ATTEN. OUTPUT jack on the main unit, the signal voltage from the main unit is coupled to first RF amplifier V201 through transformer T201. The signal voltage is amplified and coupled to second RF amplifier V202. Tuned circuits in the grid and plate circuits add gain and selectivity to the stage.

a. The signal voltage from the main unit enters the tuner at jack J201 on the front panel. The signal passes through filter FL201 and is stepped up in transformer T201. Filter FL201 keeps the input voltage standing wave ratio to a low value and makes the input circuit appear as a 50-ohm load. The stepped up voltage is connected to the tuned grid circuit of V201.

b. The tuned grid circuit consists of section A of tuning inductor L203, parallel capacitor C203, trimmer coil L204, and trimmer capacitor C204.

c. Cathode bias is provided by the voltage drop across R202. Capacitors C205 and C206 are the cathode bypasses.

d. Resistor R203 is the screen grid voltage dropping resistor. Capacitor C207 is the screen grid bypass capacitor.

e. Plate voltage is applied to the plate through resistor R204. Resistor R207 and capacitor C209 provide decoupling for the plate circuit.

f. Bypass capacitor C208 and choke L209 prevent RF currents from circulating in the heater circuit.

g. The amplified voltage in the plate circuit of V201 is developed across the parallel-tuned circuit consisting of section B of tuning inductor L203, parallel capacitor C210, trimmer coil L205, and trimmer capacitor C211.

h. The voltage across the plate tuned circuit is coupled to the grid of second RF amplifier V202 through capacitor C212.

52. Second Low-Band RF Amplifier V202 (fig. 24)

The signal voltage from first RF amplifier V201 is amplified by second RF amplifier V202 and coupled to mixer stage V203A.

a. The signal voltage from V201 is developed across grid resistor R205.

b. Cathode bias is developed by the voltage drop across R206, which is bypassed by C213 and C214.

c. Resistor R208, the screen-dropping resistor, is bypassed by C215.

d. The amplified voltage in the plate circuit is developed across the tuned plate circuit consisting of section C of tuning inductor L203, parallel capacitor C218, trimmer coil L206, and trimmer capacitor C219.

e. Bypass capacitor C216 prevents RF currents from circulating in the heater circuit.

f. The voltage across the plate tuned circuit is coupled to the grid of mixer stage V203A through capacitor C220.

53. Low-Band Mixer V203A (fig. 25)

The mixer stage, V203A, receives signals from second RF amplifier V202 and from oscillator V203B. The oscillator generates a frequency which is 10.7 mc higher than the signal frequency. The two signals are mixed within V203A, whose plate circuit is tuned to the difference frequency of 10.7 mc.

a. The signal voltage from second RF amplifier V202 is applied to the grid (pin 2) of the mixer.

b. The voltage generated by oscillator V203B is also applied to the grid of the mixer by capacitor C222.

c. The input voltages are developed across grid resistor R210.

d. Cathode bias is developed by the current flow through R211, which is bypassed by C221.

e. Resistor R217 and capacitor C230 provide decoupling for the plate circuit.

f. The plate circuit load consists of the primary of RF transformer T202 and its parallel capacitor. The coil and capacitor are tuned to 10.7 mc and suppress all other frequencies present in the plate circuit. Resistor R215 is a parasitic oscillation suppressor.

g. Bypass capacitor C228 prevents RF currents from circulating in the heater circuit.

h. The 10.7-mc voltage appears across the secondary of RF transformer T202 and is fed to first IF amplifier V207 through switch S202A and relays K201 and K202 (fig. 28).

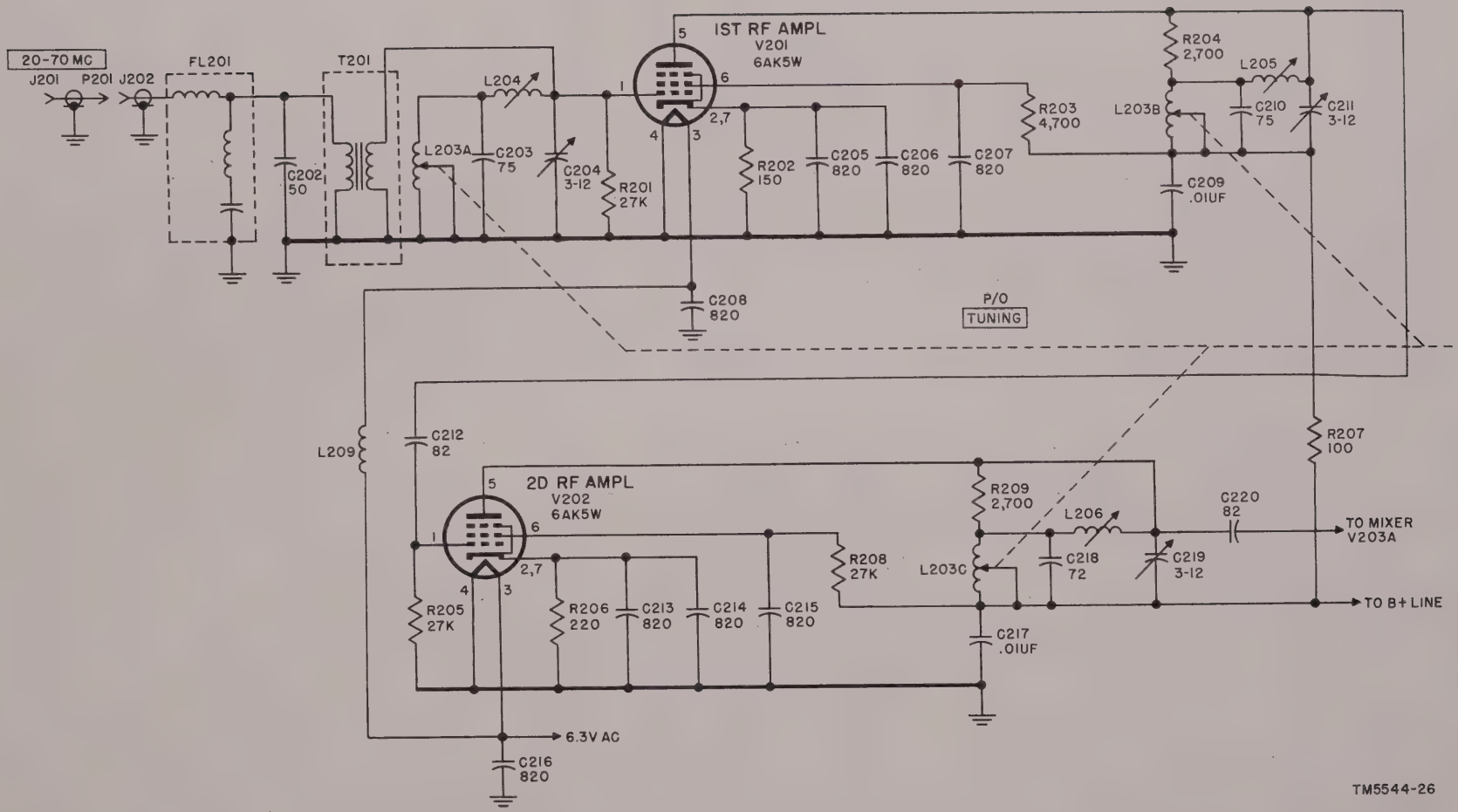


Figure 24. Lf tuner, first and second low-band RF amplifiers, schematic diagram.

54. Low-Band Oscillator V203B (fig. 25)

A Hartley oscillator circuit is used to generate the local oscillator frequency which is 10.7 mc higher than the input signal frequency. The oscillator is tuned by section D of tuning inductor L203 which is mechanically coupled to the sections that tune the first and second RF amplifiers.

a. Oscillations are produced in the plate parallel-tuned circuit consisting of section D of tuning inductor L203, parallel capacitor C224, parallel trimmer coil L208, and trimmer capacitor C226. Coil L207 is a plate choke that suppresses unwanted frequencies.

b. Feedback from the plate to the grid is made through capacitor C223.

c. Resistor R213 is the grid leak resistor. The cathode is connected directly to ground.

d. Plate voltage is applied through voltage dropping resistor R214. Resistor R216 and capacitor C229 provide decoupling for the plate circuit.

e. The oscillator output is coupled to the grid of mixer stage V203A through capacitor C222.

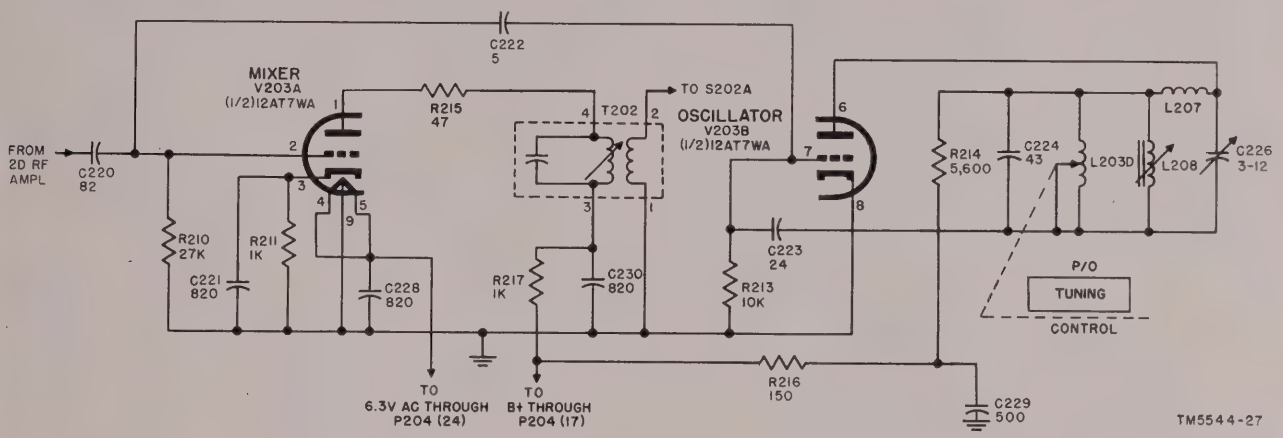


Figure 25. Lf tuner, low-band mixer and oscillator, schematic diagram.

55. First High-Band RF Amplifier V204

When the signal from the main unit is connected to J203, the voltage is coupled to first RF amplifier V204 through transformer T203. The signal voltage is amplified and coupled to second RF amplifier V205. Tuned circuits in the grid and plate circuits add gain and selectivity to the stage.

a. The signal voltage from the main unit enters the receiver at jack J203 on the front panel. The signal is stepped up in transformer T203 and is connected to the tuned grid circuit.

b. The tuned grid circuit consists of section A of tuning inductor L210, and parallel capacitor C233. Coil L211, in the grid circuit, suppresses parasitic oscillations.

c. Cathode bias is provided by the voltage drop across R219, which is bypassed by C234A and C234B.

d. Resistor R220 is the screen dropping resistor, bypassed by capacitor C234C.

e. Bypass capacitor C234D and choke L218 prevent RF currents from circulating in the heater circuit.

f. Resistor R221 lowers the Q of the tuned plate circuit. Resistor R223 and capacitor C235 provide plate decoupling.

g. The amplified voltage in the plate circuit is developed across the parallel-tuned circuit consisting of section B of tuning inductor L210, parallel capacitor C236, and coil L212. Coil L213, in the plate circuit, suppresses parasitic oscillations. The output is coupled to the grid of the second RF amplifier V205 by capacitor C237.

56. Second High-Band RF Amplifier V205 (fig. 26)

The signal voltage from first RF amplifier V204 is amplified by second RF amplifier V205 and coupled to the mixer stage V206A.

a. The signal voltage from V204 is developed across grid resistor R222.

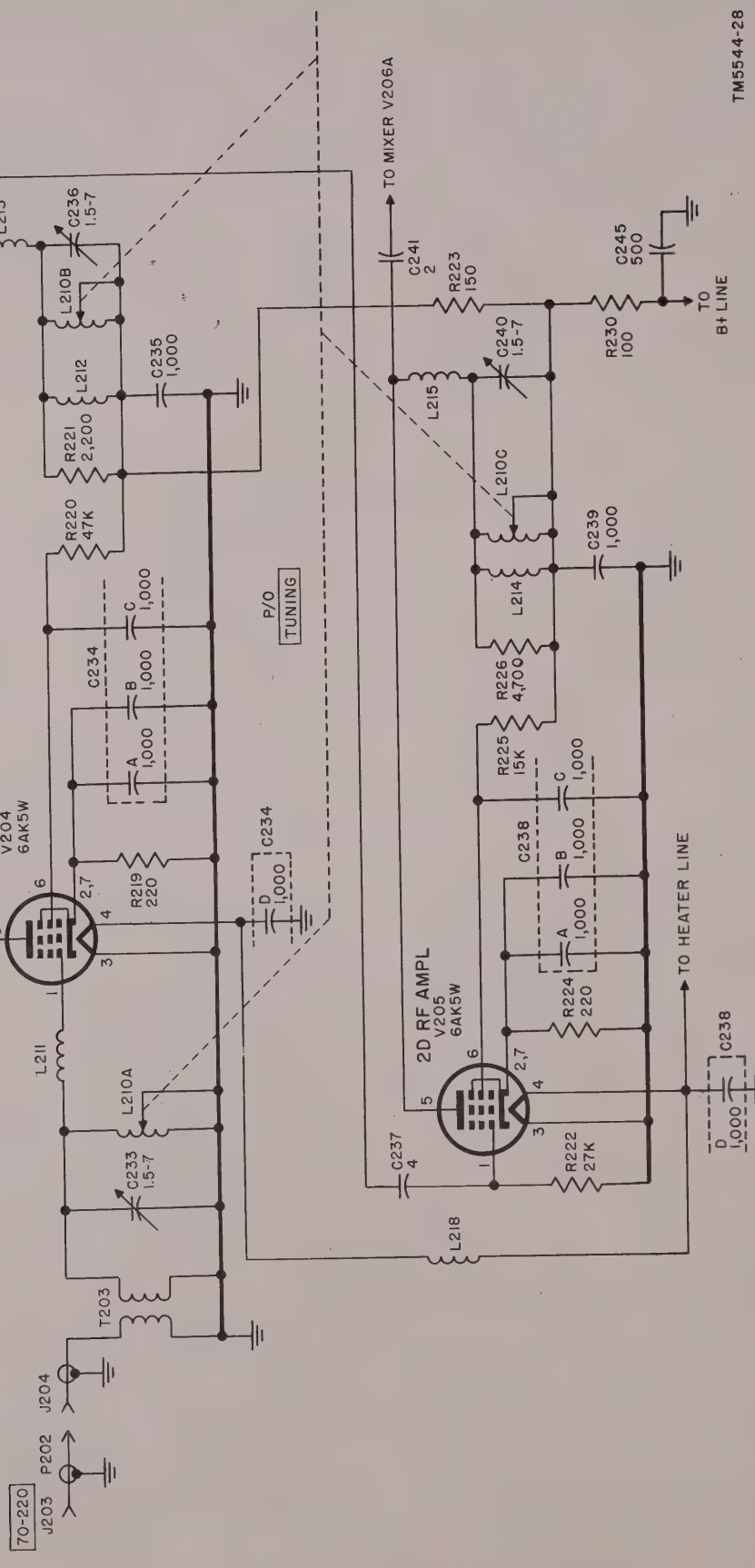


Figure 26. Lf tuner, first and second high-band RF amplifiers, schematic diagram.

b. Cathode bias is developed by the voltage drop across R224, which is bypassed by C238A and C238B.

c. Resistor R225 drops the screen voltage; it is bypassed by capacitor C238C.

d. Resistor R226 lowers the Q of the tuned plate circuit. Resistor R230 and capacitor C239 provide decoupling for the plate circuit.

e. Bypass capacitor C238D prevents RF currents from circulating in the heater circuit.

f. The amplified voltage in the plate circuit is developed across the parallel-tuned circuit consisting of section C of tuning inductor L210, capacitor C240, and coil L214. Coil L215, in the plate circuit, suppresses parasitic oscillations. The output is coupled to the grid of the mixer stage V206A through C241.

57. High-Band Mixer V206A (fig. 27)

Mixer stage V206A receives signals from second RF amplifier V205 and oscillator V206B. The oscillator generates a frequency which is 10.7 mc higher than the signal frequency. The two signals are mixed within the tube, whose plate circuit is tuned to the difference frequency of 10.7 mc.

a. Signal voltages from second RF amplifier V205 and from oscillator V206B are applied to the grid of the mixer.

b. The input voltages are developed across grid resistor R227.

c. Cathode bias is developed by the voltage drop across R229, which is bypassed by C244.

d. Resistor R228 is the screen dropping resistor; it is bypassed by capacitor C243.

e. Resistor R235 and capacitor C250 provide decoupling for the plate circuit. Resistor R232 is a parasitic oscillation suppressor.

f. Filament bypass capacitor C251 and choke L220 prevent RF currents from circulating in the heater circuit.

g. The output is developed across the primary of transformer T204 and capacitor C249, which make up a parallel-tuned circuit tuned to 10.7 mc. All other frequencies present in the output are suppressed. The secondary of T204 is connected to first IF amplifier V207 through switch S202A and relays K201 and K202 (fig. 28).

58. High-Band Oscillator V206B (fig. 27)

A modified Hartley oscillator circuit is used to generate the local oscillator frequency which is 10.7 mc higher than the input signal frequency. The oscillator is tuned by section D of tuning inductor L210 which is mechanically coupled to the sections which tune the first and second RF amplifiers.

a. Oscillations are produced in the plate parallel-tuned circuit consisting of section D of tuning inductor L210, capacitor C247, trimmer coil L217, and coil L216.

b. Feedback from the plate to the grid is made through capacitor C246.

c. Resistor R231 is the grid leak resistor. The cathode is connected to ground.

d. Plate voltage is applied through voltage dropping resistor R234. Resistor R236 and capacitor C245 provide decoupling for the plate circuit. Resistor R233 is a load across the parallel-tuned circuit.

e. The oscillator signal is coupled to the grid of the mixer through capacitor C242.

59. IF Amplifiers V207 through V210 (figs. 28 and 29)

The four IF amplifier stages are essentially the same. The first stage is described in *a* through *h* below. Corresponding parts in each stage perform the same function. A negative dc voltage is fed back to the grid of the third IF amplifier from the RF. GAIN control in the main unit to control the gain of the tuner.

a. At the 20 position of the SIGNAL INPUT ATTENUATOR control on the main unit, relay K202 is energized and a 10-db T-pad consisting of resistors R240, R241, and R242, is inserted between the mixer and first IF amplifier. At the 40, 60, 80, positions of the control relay K201 is also energized and another 10-db T-pad consisting of resistors R237, R238, and R239 in series with the first pad, is inserted between the mixer and first IF amplifier. This is done so that the RF, meter, and IF attenuation add up to the amount shown on the setting of the SIGNAL INPUT ATTENUATOR.

b. The low band output or the high band output is selected by FREQUENCY RANGE switch S202. The selected output passes

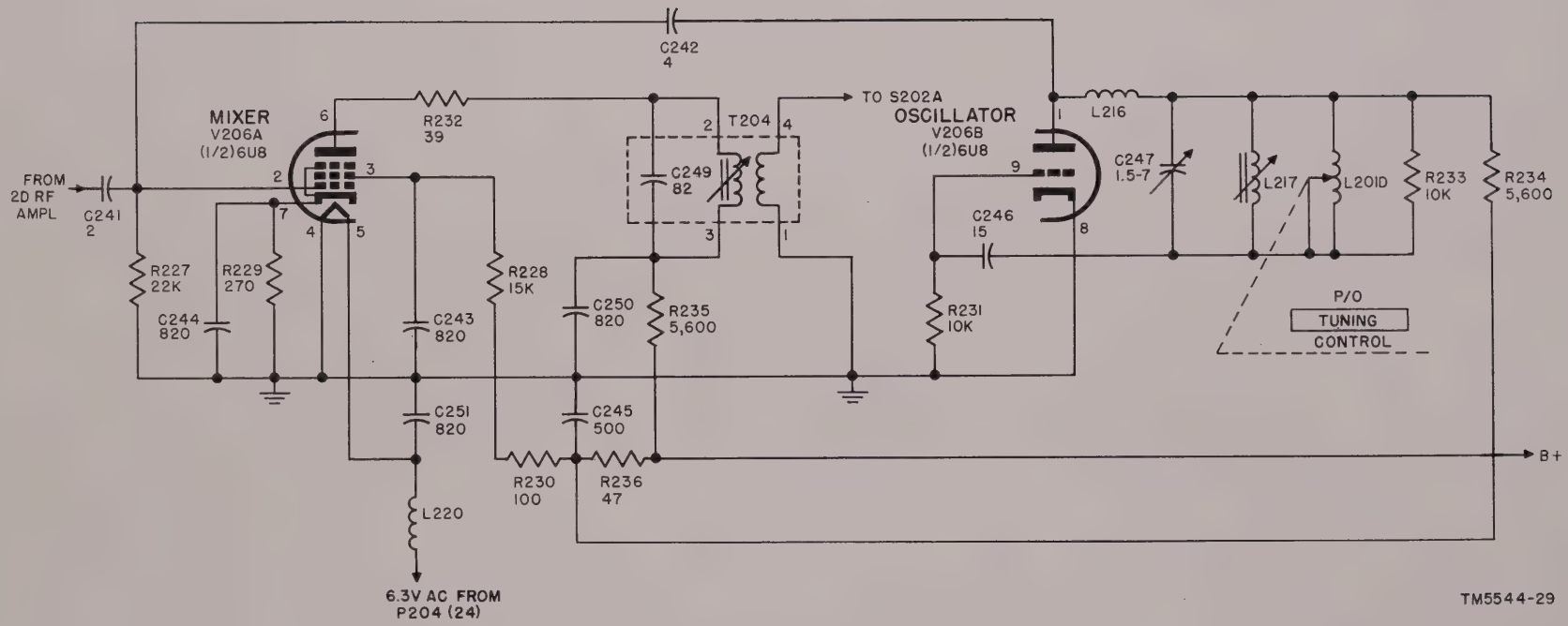


Figure 27. Lf tuner, high-band mixer and oscillator, schematic diagram.

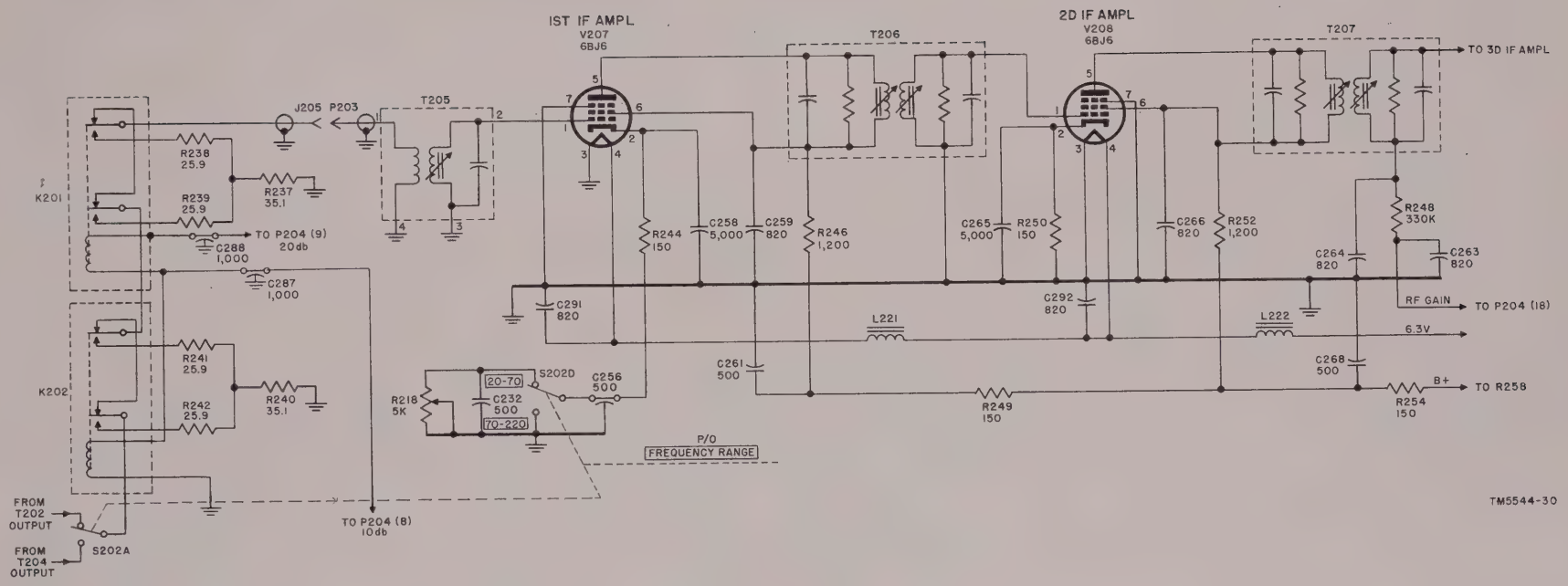


Figure 28. Lf tuner, first and second IF amplifiers, schematic diagram.

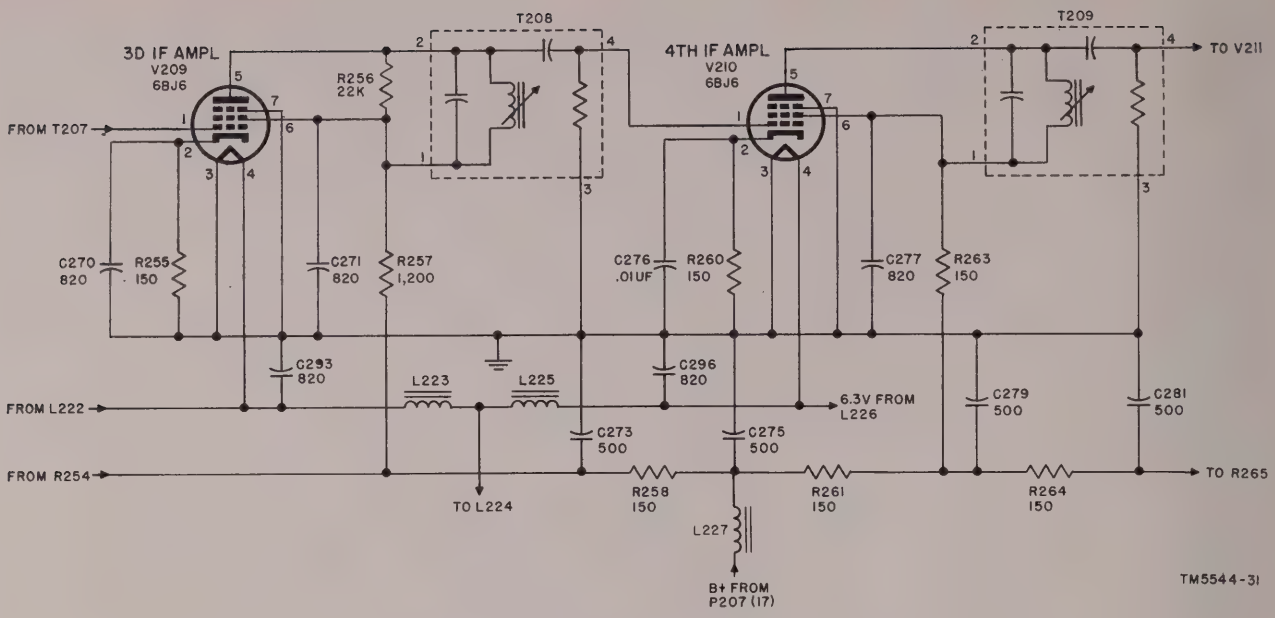


Figure 29. Lf tuner, third and fourth IF amplifier, schematic diagram.

through relays K201 and K202 to jack J205, the tuner output connector. Plug P203 connects the signal to the primary of RF transformer T205. The secondary of T205 is tuned to 10.7 mc and feeds the signal to the control grid of V207.

c. Cathode bias is supplied by the voltage drop across R244 in the position of S202. In the low band position, variable resistor R218 is placed in series with R244. Resistor R218 is adjusted so that the gain of the IF amplifier is the same on both bands. Capacitor C258 bypasses R244. Capacitor C232 bypasses R218.

d. Resistor R246 and capacitor C259 form the screen grid and plate decoupling circuit. Resistor R249 and capacitor C261 provide additional decoupling.

e. Capacitor C291 and choke L221 prevent RF currents from circulating in the heater circuit.

f. The output of V207 is applied to the primary of T206. The primary winding and the parallel capacitor resonate together at the intermediate frequency. The output of T206 is applied to second IF amplifier V208.

g. The output of the fourth IF amplifier is impedance-coupled to cathode follower V211.

60. Cathode Follower V211
(fig. 30)

Cathode follower V211 is used to feed the electrometer detector unit from a low-impedance source and to obtain good pulse response.

a. A pentode type 6AK5W has the screen grid tied to the plate and operates like a triode.

b. The IF signal from V210 is coupled to the grid of V211 by the coupling capacitor in T209 (fig. 29). The resistor in T209 is the grid resistor for V211.

c. Cathode bias is supplied by the voltage drop across R266 which is bypassed by C282. The signal voltage is developed across variable coil L228 which is in series with cathode resistor R266. The coil is adjusted for peak output.

d. The screen grid and plate are bypassed by capacitor C283. Capacitor C297 and choke L226 prevent RF currents from circulating in the filament circuit.

e. The signal voltage across coil L228 is coupled to audio detector V212 by capacitor C284 and fed directly to electrometer detector unit E400.

61. Audio Detector V212
(fig. 30)

The IF signal from cathode follower V211 is detected by V212, filtered, and fed to the main unit.

a. The IF signal from cathode follower V211 is coupled to the plate of audio detector V212 through coupling capacitor C284.

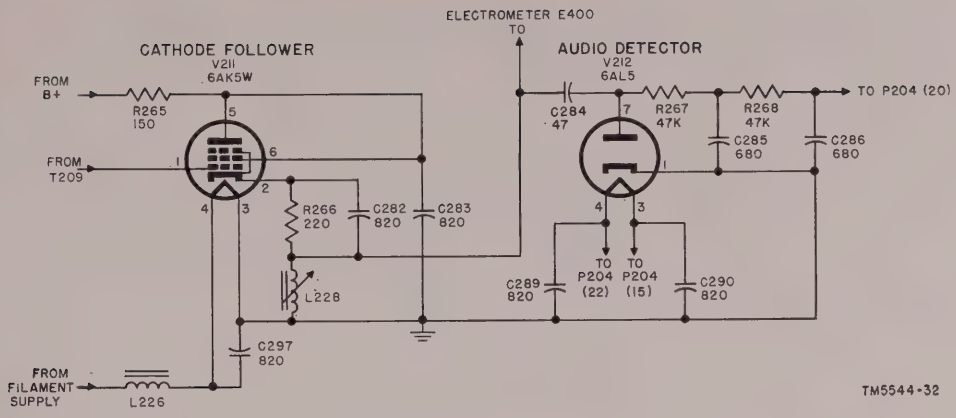


Figure 30. Cathode follower and audio detector. schematic diagram.

b. Radio frequencies are filtered from the detected audio signal by two L-sections consisting of resistors R267, R268, and capacitors C285 and C286.

c. The filtered output is fed to terminal 20 of plug P204.

d. Capacitors C289 and C290 bypass all RF filament current to ground.

62. Electrometer Detector (fig. 31)

Since it is difficult to show true peak values of pulses, especially at low repetition frequencies, the electrometer detector unit described below has been especially designed to detect these voltages. Detector tube V401 presents a very high impedance to the incoming IF signal. The current drawn is so small that the output peak or average voltage detected is the same as the input peak or average IF signal.

a. The IF signal from cathode follower V211 is coupled to the plate of V401A by capacitor C403. Because the output from the electrometer detector unit is the same as the input, the full output is present at pin 1 of the electrometer.

b. One-half of the IF signal is coupled to the plate of V410B by capacitor C404 because of the voltage divider action of parallel resistor R401 and capacitor C401 in series with parallel resistor R402 and capacitor C402. Since the output from the electrometer detector unit is the same as the input, one-half of the input signal is present at pin 10 of the electrometer. This signal is applied to one side of the meter. The full input signal (*a* above) is applied to the other side of the meter. The difference is used to give an indication of the signal level.

c. In the CW. PEAK and PULSE PEAK positions of the function switch on the main unit, thermal switches V402 and V403 are open. Resistor R404 which is 20,000 megohms is the load for V401A. Capacitor C403 charges very fast and discharges very slowly so that peak values are detected. In the CW. AVERAGE position, thermal switches V402 and V403 are closed. Resistor R406 becomes the load for V401A and average values are detected. Resistor R405 is the load for V401B and capacitor C404 is the charging capacitor. Resistor R407 is the load for V401B when thermal switch V403 is closed.

d. Resistor R408 in series with the control grid of V404 is 2,000 megohms so that almost no grid current is drawn. Capacitor C405 places the grid at low RF potential. Resistor R411 in series with the grid of V405 is 2,000 megohms so that almost no grid current is drawn. Capacitor C406 places the grid at low RF potential.

e. Capacitor C407 places the plate of V404 at low RF potential. The dc output at pin 1 is the full input at the plate of V401A.

f. Capacitor C411 places the plate of V405 at low RF potential. The dc output at pin 10 is one-half of the full input which was coupled to the plate of V401B.

g. Capacitors C408 and C409 bypass the filament of V404 to ground. Capacitors C412 and C413 bypass the filament of V405 to ground.

h. Resistor R403 is a voltage dropping resistor in series with the filament of V401. Capacitor C414 bypasses the filament to ground.

i. Resistor R409 is in series with the heater of V402. Resistor R410 is in series with the heater of V403. Capacitor C410 bypasses both heaters to ground.

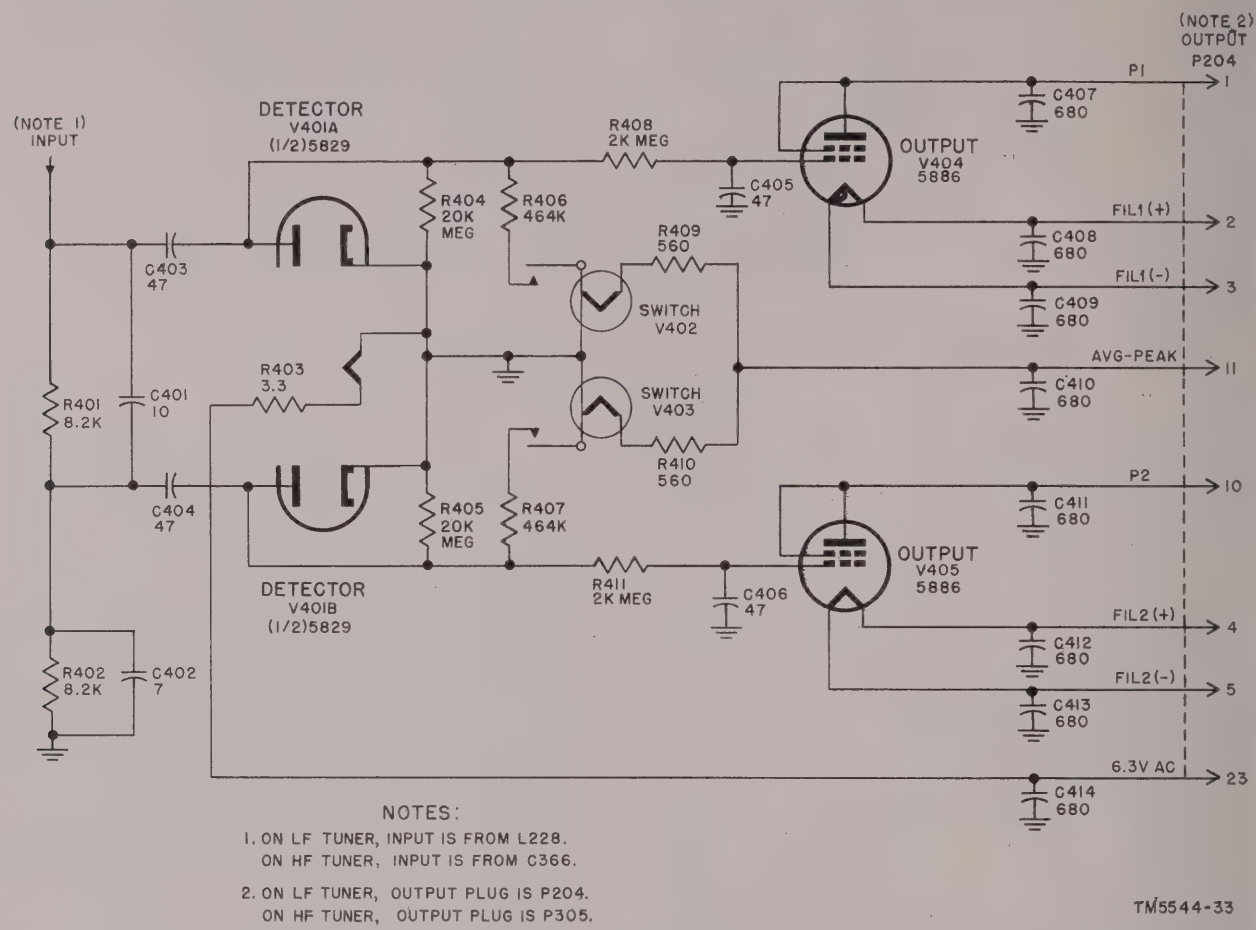


Figure 31. Electrometer detector unit, schematic diagram.

Section IV. THEORY OF RADIO FREQUENCY TUNER TN–327/URM–7

63. Block Diagram of HF Tuner

The block diagram for the hf tuner is shown in figure 32. For complete circuit details, refer to figure 56.

a. RF Amplifier V301. RF amplifier V301 is a low noise amplifier. It amplifies the signal from the main unit and its output is coupled to mixer CR301.

b. Oscillator, V302. The oscillator generates a signal 42 mc above the incoming signal. Its output is coupled to mixer CR301.

c. Mixer, CR301. The signals from RF amplifier V301 and from the oscillator V302 are mixed in this stage. Sum and difference frequencies are obtained. The stage is tuned to the difference frequency of 42 mc; therefore, all other frequencies are suppressed. The difference frequency of 42 mc is applied to cascode amplifier V303.

d. Cascode Amplifier V303. Cascode amplifier V303 consists of two triodes: the cascode driver and the grounded grid amplifier. This stage amplifies the 42-mc IF frequency and transformer-couples the output to first IF amplifier V304.

e. IF Amplifiers. The five IF amplifiers, V304 through V308, are essentially alike. Each stage adds signal gain and selectivity.

f. Audio Detector, V309. Audio detector V309 detects the audio signal and feeds it to audio amplifier V101 in the main unit.

g. Electrometer Detector Unit. The electrometer presents a very high impedance to the

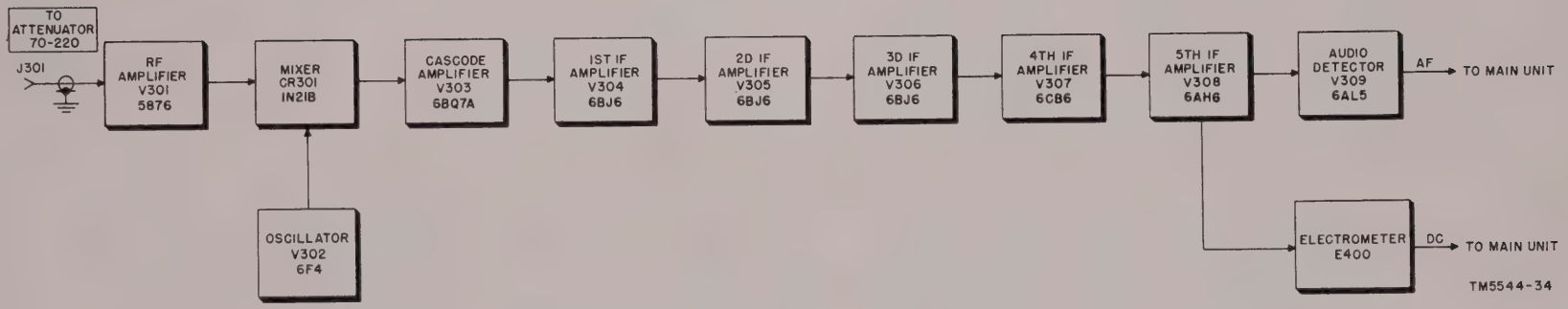


Figure 32. Hf tuner block diagram.

signal so that no signal loss is made in coupling the signal to the cathode follower. The peak or average envelope peak voltage is fed to cathode follower V108 in the main unit.

64. RF Amplifier V301
(fig. 33)

The signal voltage from the main unit is coupled to RF amplifier V301. A grounded grid triode amplifier is used because of its low noise characteristic. Tuned circuits in the cathode and plate circuits add gain and selectivity to the stage. The amplified output is inductively coupled to mixer CR301.

a. The signal voltage from the main unit enters the receiver at jack J301 on the front panel. The signal is connected to filter FL301 through a coaxial cable. Plug P302 connects to jack J303 on the output of the filter and feeds the signal to a parallel-tuned circuit consisting of variable capacitor C301 and coil L301. Coil L301 is closely coupled to coil L302; this keeps the input voltage standing wave ratio (vswr) to a low value.

b. The tuned cathode circuit consists of parallel variable capacitors C302 and C303 and coil L302. Capacitor C303 is mechanically coupled to variable capacitor C305 in the plate circuit of V301 and variable capacitor C308 in the tuned circuit of oscillator V302 so that the amplifier and oscillator track over the frequency range. Trimmer capacitor C302 is used for alinement purposes. Cathode bias is developed by the voltage drop across R301, which is bypassed by C304.

c. The grid is connected directly to ground.

d. Coil L307 is an RF choke to decouple the stage from the power supply. Additional decoupling is provided by R302 and C313.

e. The amplified voltage in the plate is developed across the parallel-tuned circuit consisting of capacitor C350 and coil L303. Capacitor C306 is used for alinement purposes.

f. Chokes L309A, L309B, and L311, with capacitors C316 and 319 prevent RF currents from circulating in the heater circuit.

g. Capacitors C314 and C315 filter the input B+ voltage.

h. The output across coil L303 is inductively coupled to coil L304 in the mixer stage.

65. Oscillator V302
(fig. 33)

A Hartley oscillator circuit is used to generate the local oscillator frequency which is 42 mc higher than the input signal frequency. The oscillator is tuned by capacitor C308 which is mechanically coupled to the capacitors that tune the RF amplifier.

a. Oscillations are produced in the tuned plate circuit that consists of coil L306, tuning capacitor C308, and trimmer capacitor C309.

b. Feedback to the grid is made through capacitor C310.

c. Resistor R306 is the grid leak bias resistor. The cathode is connected directly to ground.

d. Coil L308 and resistor R303 in parallel form a parasitic suppressor. Plate voltage is filtered by resistors R304 and R305 and capacitors C311 and C312.

e. Capacitors C317 and C318 and coil L310 prevent RF currents from circulating in the heater circuit.

f. The frequency generated across coil L306 is inductively coupled to coil L304 in the mixer stage.

66. Mixer CR301
(fig. 33)

The input signal and the local oscillator signal are mixed in this stage. All frequencies are suppressed except the difference frequency of 42 mc, which is fed to the cascode amplifier.

a. The signal from RF amplifier V301 is inductively coupled to the mixer by coil L304.

b. The signal generated by oscillator V302 is inductively coupled to the mixer by coil L304.

c. The two signals are mixed by CR301.

d. Coil L304 and variable capacitor C307 are tuned to 42 mc which is the frequency difference between the two applied signals. The difference frequency is fed to output coil L305.

e. A portion of the output across coil L305 is fed directly to jack J304.

67. Cascode Amplifier V303
(fig. 34)

A cascode amplifier is used because it is a low noise stage which is desirable for low level signals. Its low input impedance matches the low output impedance of the coupling circuit.

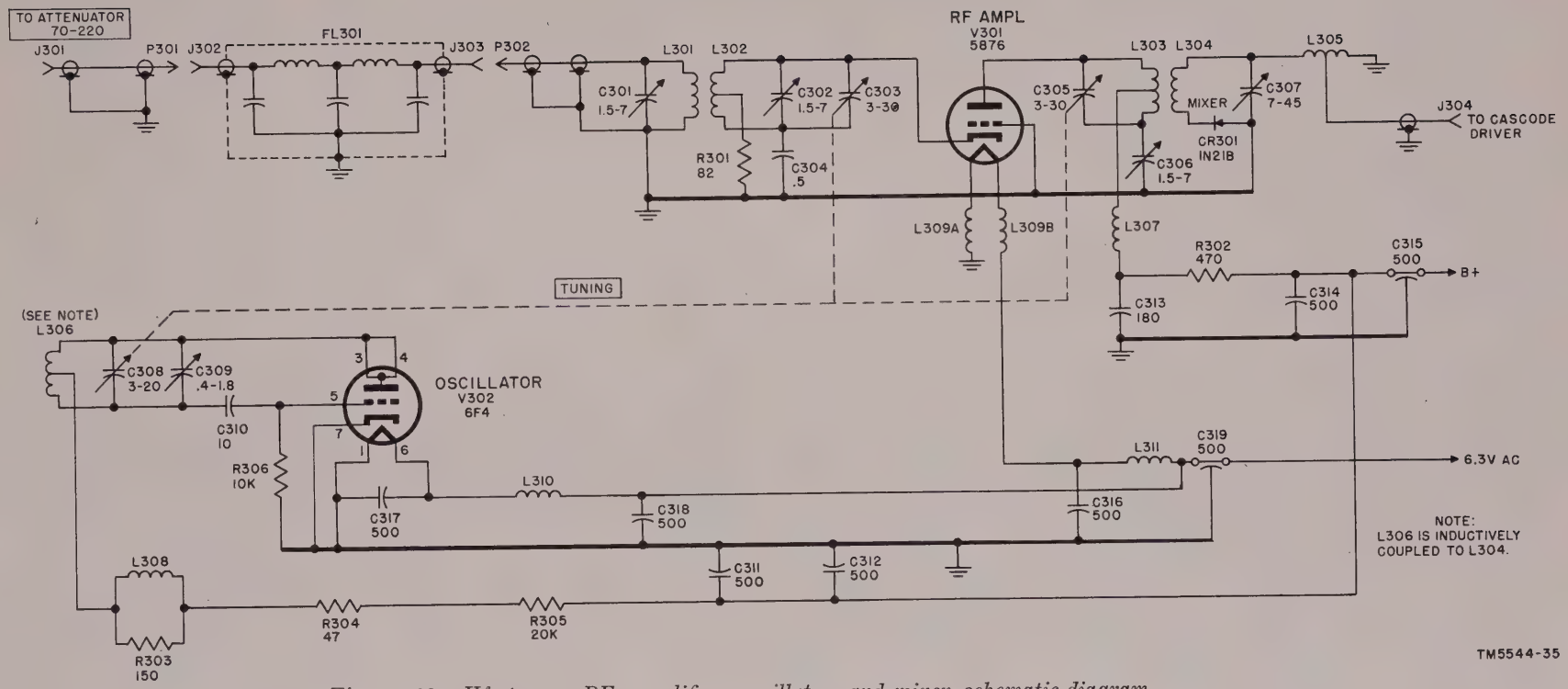


Figure 33. Hf tuner, RF amplifier, oscillator and mixer, schematic diagram.

The amplifier consists of a triode driver and grounded grid amplifier. The amplified output is transformer coupled to the first IF amplifier.

a. Plug P303 connects to hf tuner output jack J304 and couples the signal to a tap on coil L312.

b. The input IF signal is stepped up in coil L312 and connected to the grid of cascode driver V303A. Capacitor C323 resonates with L312 at the intermediate frequency.

c. Cathode bias is developed by the voltage drop across R308, which is bypassed by C322.

d. Part of the amplified voltage across plate load resistor R309 is coupled back to the grid by capacitor C324 through neutralizing coil L313, which is adjusted to neutralize the plate-to-grid capacitance and prevent the triode from oscillating.

e. Resistor R311 and capacitor C333 provide decoupling for the plate circuit.

f. The output developed across the plate load is coupled to the cathode of grounded grid amplifier V303B through C325.

g. Cathode bias is developed by the voltage drop across R310, which is bypassed by C326. Coil L314 in series with the cathode resistor is adjusted to peak the output.

h. The grid is connected directly to ground.

i. Chokes L317A and L317B and capacitor C339 prevent RF currents from circulating in the heater circuit.

j. The output of V303B appears in the primary of T301. The primary winding and the shunt capacitor resonate together at the intermediate frequency. The output of T301 is fed to first IF amplifier V304.

68. First, Second, Third, Fourth, and Fifth IF Amplifiers V304 Through V308
(figs. 34–36)

The five IF amplifier stages are essentially alike. The first IF amplifier is described in *a* through *h* below. Corresponding parts in each stage perform the same function. A negative dc voltage is fed to the grids of the second and third IF amplifiers from the RF. GAIN control in the main unit to control the gain of the tuner.

a. The IF signal across the secondary of T301 is connected to the grid of V304. The secondary winding and the shunt capacitor resonate together at the intermediate frequency.

b. Cathode bias is developed by the voltage drop across R316, which is bypassed by C330.

c. Resistors R317 and R318 and capacitors C332 and C335 form the screen grid and plate decoupling circuit.

d. Capacitor C340 and chokes L319 and L320 prevent RF currents from circulating in the heater circuit.

e. B+ voltage is fed through filter FL302 which prevents RF voltages from entering the IF chassis through the B+ line.

f. The ungrounded side of the heater voltage is fed through filter FL303 which prevents RF voltage from entering the IF chassis through the heater line.

g. The output of V304 appears in the primary of T302. The primary winding and the shunt capacitor resonate together at the intermediate frequency. The secondary winding output is coupled to second IF amplifier V305 through two IF attenuators.

69. Audio Detector V309
(fig. 37)

The IF signal from the fifth IF amplifier is detected by the audio detector, is filtered, and fed to the main unit.

a. The IF signal from V308 is coupled to the plate of audio detector V309.

b. Tube V309 acts as a half-wave rectifier. Half of the IF signal is eliminated and the RF frequencies are filtered out.

c. The detected audio signal is filtered by two L-sections consisting of resistors R349 and R350 and capacitors C368 and C369.

d. The output is fed to the main unit through terminal 20 of plug P305.

e. Feed-through capacitors C370 and C371 filter RF currents from the balanced 6.3-volt ac heater circuit.

70. Electrometer Detector

The electrometer detector unit is used to detect the envelope voltage of the IF signal with negligible loss so that the full output from fifth IF amplifier V308 is connected to detector and meter stage V108 on the main chassis. This unit is the same as that covered in paragraph 62.

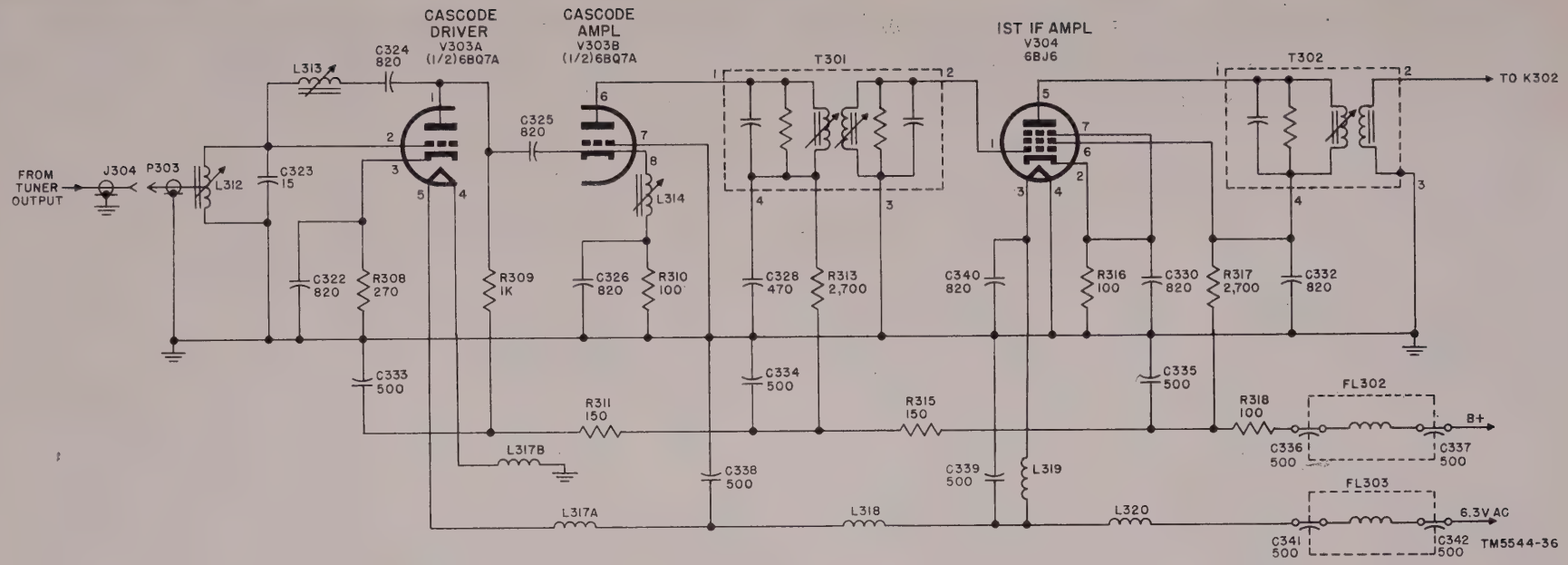


Figure 34. Cascode and first IF amplifiers, schematic diagram.

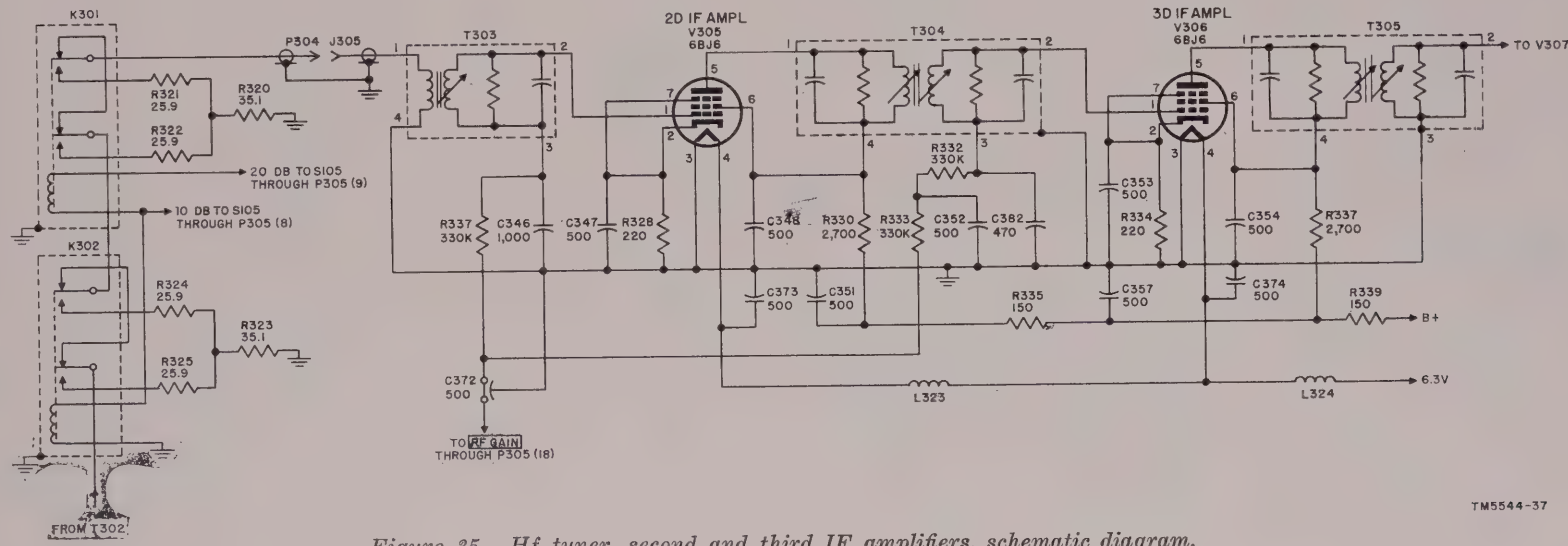


Figure 35. Hf tuner, second and third IF amplifiers, schematic diagram.

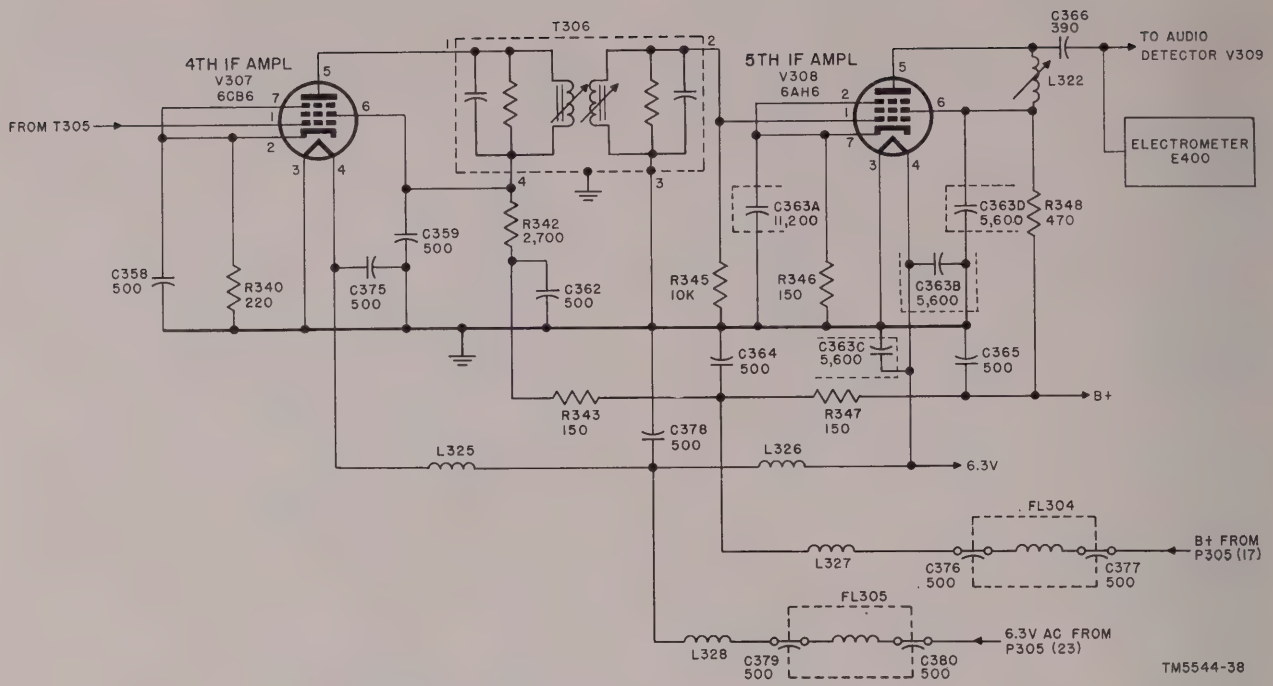


Figure 36. Hf tuner, fourth and fifth IF amplifiers, schematic diagram.

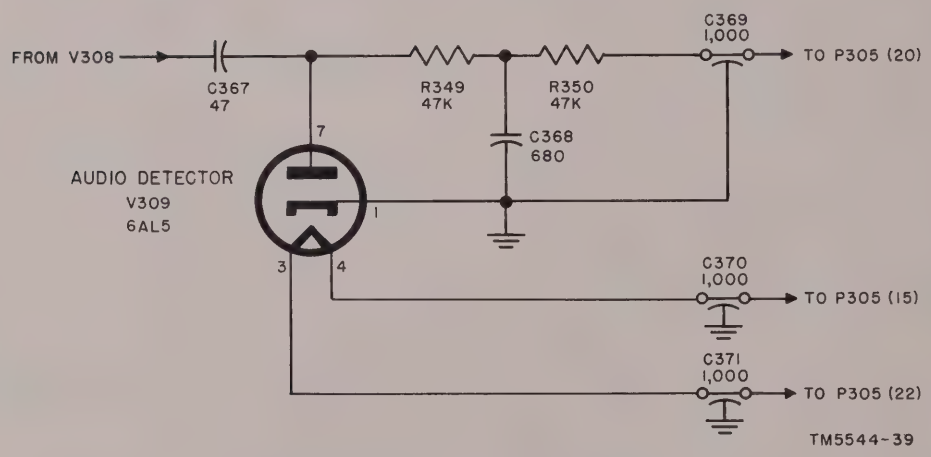


Figure 37. Hf tuner, audio detector, schematic diagram.

Section V. THEORY OF POWER ISOLATION AND STEPDOWN TRANSFORMER TF–248/G AND MOTOR-GENERATOR PU–388/U

71. Transformer
(fig. 38)

a. The transformer covers the frequency range of 50 to 400 cycles. It can operate from a 115- or 230-volt source and provides a 115-volt output.

b. Switch S802 on the front panel connects the two primaries in parallel for 115-volt operation and in series for 230-volt operation.

c. The power cord at the rear is plugged into the ac source. Fuse F801 protects the equipment from overload.

d. Transformer T801 couples the 115- or 230-volt input to the secondary which is filtered by capacitors C801 and C802. The 115-volt output is connected to receptacle J801.

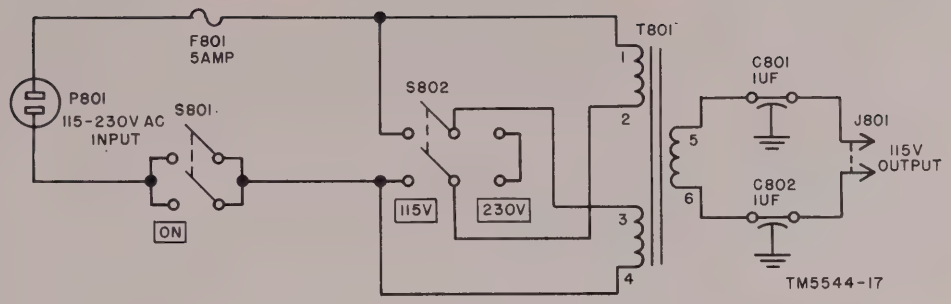


Figure 38. Power Isolation and Stepdown Transformer TF–248/G, schematic diagram.

72. Motor-Generator PU–388/G
(fig. 39)

a. Motor-Generator PU–388/G consists of a 23- to 29-volt dc motor and a 117-volt ac generator using a common field winding. The motor and generator windings are mounted on opposite ends of the shaft.

b. A battery cord is used to connect the motor-generator to a 24-volt battery. One end is connected to receptacle J701 and the other end is connected to the battery, using battery clips at the end of the cord.

c. The 24 volts from the battery is applied to J701 and the 115-volt ac output is taken from receptacle J702. Fuse F701 protects the motor-generator from overload.

d. Filter FL701 keeps internally generated interference out of the equipment. A filter consisting of C701, C702, C703, C704, L701 and L702 keeps motor RF noise out of the dc input line.

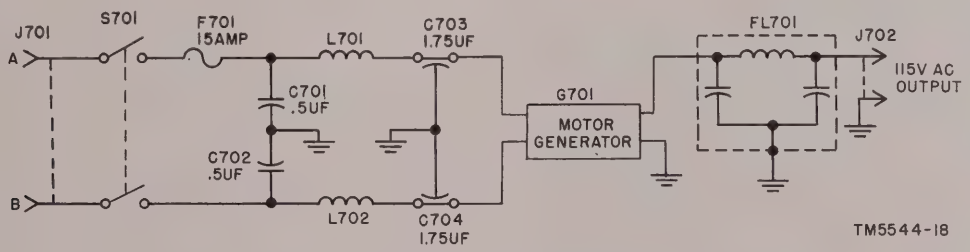


Figure 39. Motor-Generator PU–388/G, schematic diagram.

CHAPTER 5
FIELD MAINTENANCE

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning: When servicing the test set, be present. Before touching any of the parts, nected from the main unit, and discharge all extremely careful because of the high voltages to be sure that the ac power cord is disconfilter capacitors in the power supply.

73. General Instructions

Troubleshooting at field and depot maintenance level includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. The field maintenance and depot procedures are not complete in themselves, but supplement the procedures described in paragraphs 34 through 37. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at an organizational level, must be completed by means of sectionalization, localization, and isolation techniques.

74. Troubleshooting Procedures

a. General. The first step in servicing a defective test set is to sectionalize the fault. Sectionalization means tracing the fault to a major component or circuit responsible for abnormal operation. The second step is to localize the fault. Localization means tracing the fault to a defective part responsible for the abnormal condition. Some faults, such as burned-out resistors and arcing transformers, often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltages and resistances.

b. Sectionalization. The test set consists of several units: the various antennas and probes, the tuners, the main unit, and the motor-generator and transformer when their use is required. The first step in tracing trouble is to locate the unit or units at fault by the following methods:

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits. All meter readings or other visual signs should be observed and an attempt made to sectionalize the fault to a particular unit.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The equipment performance check list (par. 36) is a good operational test.

c. Localization. The tests listed below will aid in isolating the trouble. First, localize the trouble to a single stage or circuit, and then isolate the trouble within that circuit by voltage, resistance, and continuity measurements.

(1) *Voltage and resistance measurements.* These measurements will help locate the individual component part at fault. Use resistor and capacitor color codes (figs. 53 and 54) to find the value of the components. Use voltage and resistance diagrams (figs. 44, 48, and 52) to find normal readings and compare them with readings taken.

(2) *Troubleshooting chart.* The trouble symptoms listed in the chart (par. 77) will aid in localizing trouble to a component part.

(3) *Signal substitution.* Signal substitution (par. 79) procedures enable the repairman to localize a trouble quickly to a stage.

(4) *Intermittent troubles.* In all these tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. Check the wiring and connections to the units of the test set.

75. Test Equipment Required

The following chart lists test equipment required for troubleshooting the test set, the associated technical manuals, and the assigned common names.

Test equipment	Technical manual	Common name
Electronic Multimeter TS–505A/U.	TM 11–5511A	Vtvm
Electron Tube Test Set TV–7/U.	TM 11–5083	Tube tester
Signal Generator TS–497B/URR.	TM 11–5030A	Signal generator

Section II. TROUBLESHOOTING THE TEST SET

76. Checking B+ and Filament Circuits for Shorts

Trouble within the equipment often may be detected by checking the resistance of the filament and high-voltage circuits before applying power. Make the following checks before attempting to put the equipment into operation. Leave the power cord disconnected.

a. +150-Volt Supply. Check the resistance at the junction of resistors R102 and R103 on terminal board TB101. The resistance should be approximately 13,000 ohms. A low resistance reading may be due to a shorted capacitor C101 or a short in rectifier tube V101 or V102. A high resistance reading may be due to an open resistor R127, an open filter FL104, or an open relay coil in K101.

b. —150-Volt Supply. Check the resistance at pin 1 of rectifier tube V103. The resistance should be approximately 55,000 ohms. A low resistance reading may be due to shorted capacitors C102 and C103 or shorted tubes V103 and V104. A high resistance reading may be due to an open resistor R104, R105, R106, or R110.

c. 300-Volt Supply. Check the resistance at terminal 11 of transformer T101. The resistance should be approximately 1.4 megohms. A low resistance reading may be due to a faulty diode CR101 or shorted capacitor C104. A high resistance reading may be due to an open diode CR101 or an open resistor R109.

d. Low-Voltage Electrometer Supplies. Check the resistance across terminals 2 and 3 or 4 and 5 of connector J102. The components in the two filament supplies are identical. The resistance should be approximately 1.5 megohms. A low resistance reading may be due to shorted capacitors C105 and C106 or shorted diodes CR102 and CR103. A high resistance reading may be due to open resistors R112 and R113 or open diodes CR102 and CR103.

77. Localizing Troubles

a. General. In the troubleshooting chart (*c* below), procedures are outlined for sectionalizing trouble to a stage within the various sections of the indicator. Parts locations are indicated in figures 40 through 43, 45 through 47, and 49 through 51. Voltage and resistance measurements are shown in figures 44, 48, 52. Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary. When trouble has been localized to a particular stage, use voltage and resistance measurements to isolate the trouble to a particular part.

b. Use of Chart. The troubleshooting chart is designed to supplement the operational checks detailed in paragraph 36. If previous operational checks have produced a symptom listed in this chart, go directly to the symptom. If no operational symptoms are known, begin with item 1 of the equipment performance check list and proceed until a symptom of trouble appears.

Caution: If operational symptoms are not known or if they indicate the possibility of short circuits within the equipment, make the short-circuit checks described in paragraph 76 before applying power.

c. Troubleshooting charts.

(1) *Motor-generator.*

Symptom	Probable trouble	Correction
1. Battery cable connected to 24-volt source; power switch in ON position. Motor-generator does not run.	Open choke L701 or L702; open feed-through capacitor C703 or C704; shorted capacitor C701 or C702.	Check parts and replace if necessary.
	Open 24-volt winding in armature	Check for continuity at input of motor generator; if open is indicated, replace motor-generator.
	Open power switch	Check S701 for continuity; replace if necessary.
2. Motor-generator runs; no output at output receptacle.	Defective filter FL701	Check for 115 volts ac at input to FL701; if it is present, replace the filter.
	Open 115-volt winding in armature	Check for continuity at output of motor-generator; if open is indicated, replace motor-generator.

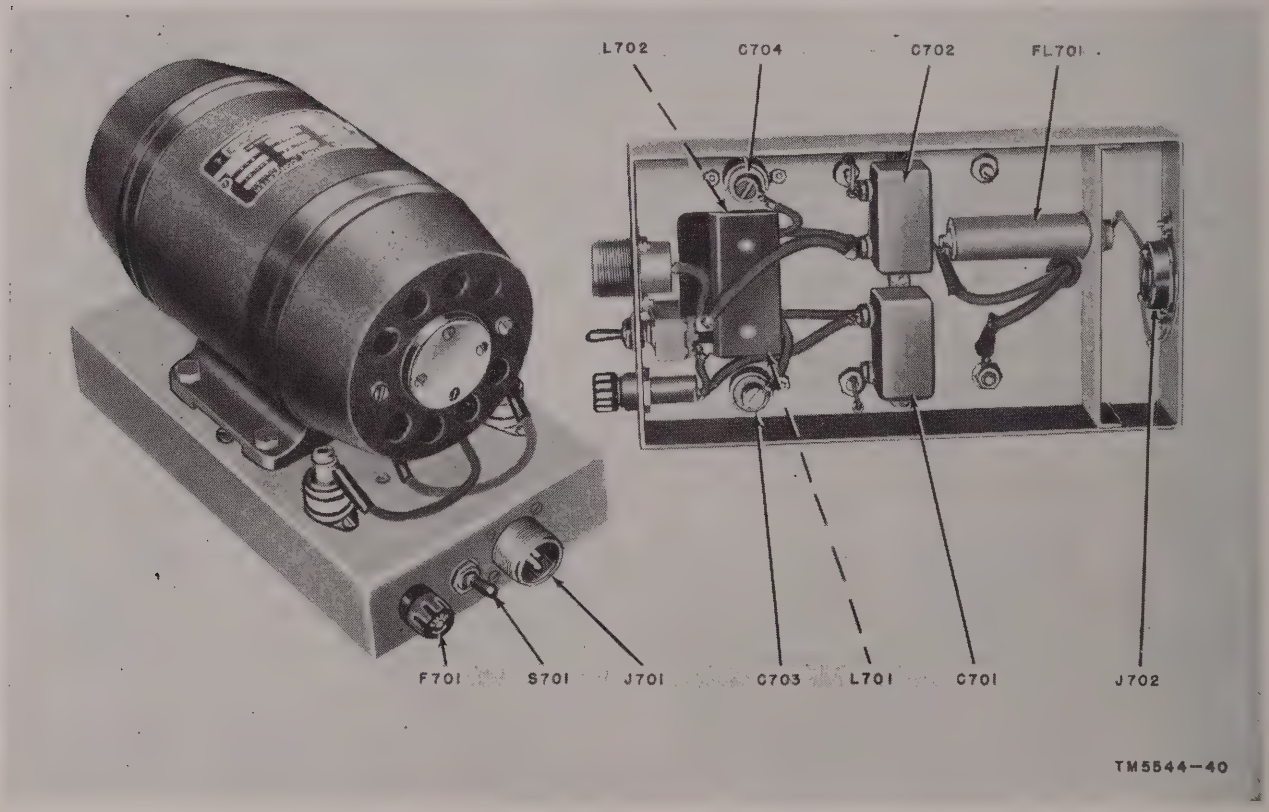


Figure 40. Motor-generator, top and bottom views, covers removed.

(2) *Transformer.*

Symptom	Probable trouble	Correction
1. Power cord plugged into 115-volt source; power switch in ON position; no output.	Open secondary in transformer	Check continuity between terminals 5 and 6 of T801. If open is indicated, replace transformer.
	Open feedthrough capacitor C801 or C802.	Check for 115 volts ac at terminals 5 and 6 of T801. If voltage is present, check capacitors for continuity and replace if necessary.
	Open power switch or open 115 V–230 V switch.	Check switches and replace if necessary.
2. Output available when 115 V–230 V switch is in 115 V position, but not when switch is in 230 V position.	One primary of T801 open	Check for continuity between terminals 1 and 2 and between ter minals3 and 4 of T801. If open is indicated, replace transformer.
	Defective 115 V–230 V switch	Check switch for proper continuity and replace if necessary.

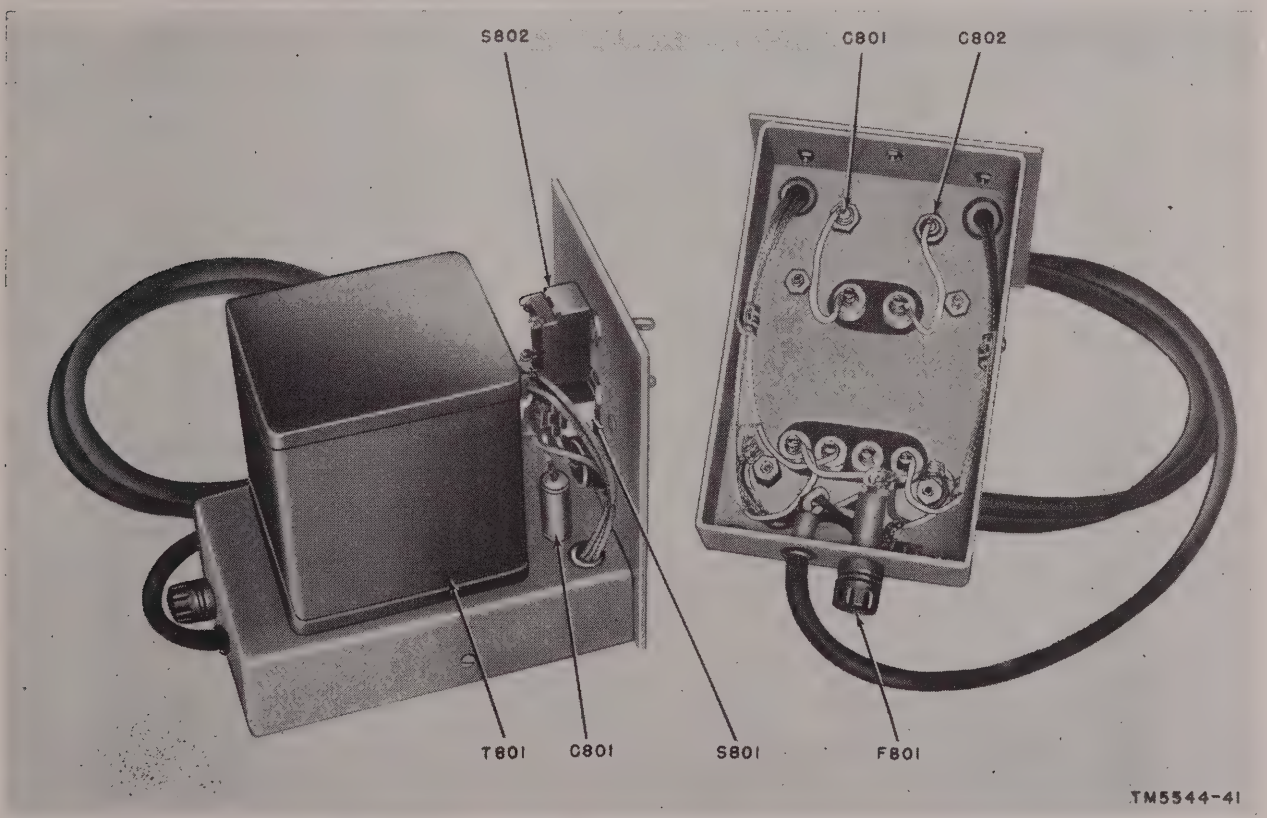


Figure 41. Transformer, top and bottom views, covers removed.

(3) *Tuners and main unit.*

Symptom	Probable trouble	Correction
1. Power switch at ON; pilot and MEGACYCLES dial illumination lamps do not light.	Defective power switch	Check switch continuity; replace if necessary.
	Dirty or defective interlock switch in tuner or main unit.	Check interlock switches; clean or replace if necessary.
	Open secondary (terminals 9 and 10) or open primary of power transformer.	Check continuity of primary (terminals 1 and 2) and between terminals 9 and 10 of transformer. If open is indicated, replace transformer.
2. Pilot and MEGACYCLES dial illumination lamps light; equipment does not operate.	Open secondary of power transformer	Check continuity between terminals 15 and 16, 16 and 17, 11 and 12, 3 and 4, 4 and 5, 6 and 7, 7 and 8, 18 and 19, 19 and 20, 13 and 14 of power transformer. Replace transformer if open is indicated between any pair of terminals listed.
	Defective rectifier CR101 through CR 106	Check rectifiers and replace any found defective.
	No B+	Measure voltage at terminal 17 of P102. If less than 150 volts is present. Check R102, R103, L101, C101A and C101B.
3. IMPULSE GENERATOR switch at ON; no audio heard in headset.	Defective resistor or capacitor in repetition rate generator stage V109B or in impulse generator driver stage V109A.	Make voltage and resistance checks; replace any defective parts.
	Open coil or dirty contacts of relays K102 and K103.	Check coils with an ohmmeter; repair or replace if necessary. Clean contacts.
	Defective attenuators AT103 or AT104	Check with an ohmmeter; replace if necessary.
	Open resistor in attenuators AT101 or AT102.	Check the resistors with an ohmmeter; replace if necessary.
	Impulse generator G101 inoperative	Replace impulse generator.
	Defective RF cord between main unit and tuner.	Check continuity of RF cord with ohmmeter; repair or replace if defective.
	Defective tuner stage	On lf tuner, if trouble occurs with FREQUENCY RANGE switch on 20–70 mc range, change to 70-220 mc range. If trouble disappears, it can be assumed that the trouble is in the 20–70 mc RF section. Refer to signal substitution charts (par. 79) to locate the defective part. The trouble is in the 70–220 mc RF section if no signal is heard on this range but is heard on the 20–70 mc range. If the trouble persists on both ranges, replace the lf tuner with the hf tuner. If the trouble disappears, it can be assumed that the trouble is in the IF or detector stage of the lf tuner. Refer to signal substitution charts (par. 79) to locate the defective part. The trouble is in the hf tuner if it appears with the hf tuner in place and disappears with the lf tuner in place. Refer to signal substitution charts (par. 79) to locate the defective part.
	Defective coupling capacitor C112	Check capacitor and replace if defective.
	Defective VOLUME control R131	Check potentiometer R131 and replace if defective.

Symptom	Probable trouble	Correction
	Defective resistor or capacitor in first audio amplifier stage V107A.	Use a voltohmmeter to make voltage and resistance measurements to locate the defective part.
	Defective coupling capacitor C117	Check capacitor for short or open and replace if defective.
	Defective resistor or capacitor in second audio amplifier stage V107B.	Use a voltohmmeter to make voltage and resistance measurements to locate the defective part and replace.
	Open primary or secondary of output transformer T102.	Use an ohmmeter to check windings and replace if defective.
	Defective capacitor C120 or open coil L102.	Check capacitor and coil and replace defective part.
	Defective jack J103 or J104	Use an ohmmeter to check for a short and replace the defective jack.
4. Audio heard in headset but no indication on meter with function switch at any position.	Defective resistor R147 thru R152	Use an ohmmeter to check resistors and replace defective resistor.
	Defective switch S106	Clean and repair or replace switch.
	Open capacitor C122 or C123	Place capacitor of equal value across the one in the circuit. If meter deflects replace defective capacitor.
	Open resistor R146	Use an ohmmeter to check the resistor and replace if defective.
	Defective jack J105	Use an ohmmeter to check continuity and replace if defective.
	Defective meter M101	Check by plugging in external meter. If it operates replace M101.
5. No indication on meter with function switch at CW. AVERAGE position.	Open meter shunt resistor R153 or R157	Use an ohmmeter to check resistor and replace if open.
	Open resistor R237 thru R242 in lf tuner or R320 thru R325 in hf tuner.	Use an ohmmeter to check resistor and replace if open.
6. Meter cannot be zeroed with function switch at ZERO ADJ.	Open resistor R143	Use an ohmmeter to check resistor and replace if open.
7. No indication on meter with function switch at PULSE PEAK position.	Open meter shunt resistor R140, R141, R142.	Use an ohmmeter to check resistors and replace if open.
8. No indication on meter with function switch at METER SLIDEBACK position.	Open resistor R137 or R138	Use an ohmmeter to check resistors and replace if open.
9. Hissing noise is not heard in headset when RF. GAIN control on main unit is fully clockwise.	Low plate or screen grid voltage in some stage of tuner.	Check all plate and screen grid voltages to locate defective resistor or capacitor and replace defective part.
	RF or IF circuits not properly alined	Refer to paragraphs 83 and 84 for IF and RF alinement procedures.
10. Intermittent noise	Defective resistor, capacitor, connection, or tube.	With an insulated prod, gently tap and slightly move all tubes, resistors, capacitors and soldered connections to locate loose elements in tubes or loose connections to any component.
11. Oscillation (indicated by whistle or howl).	Pour shielding, interstage coupling, or poor ground connections to chassis.	Ground grids of each stage in turn through a .1-μf capacitor; work from input to output until oscillations cease. Trouble may be in stage whose grounded grid caused oscillations to stop or in preceding stage or group of stages.

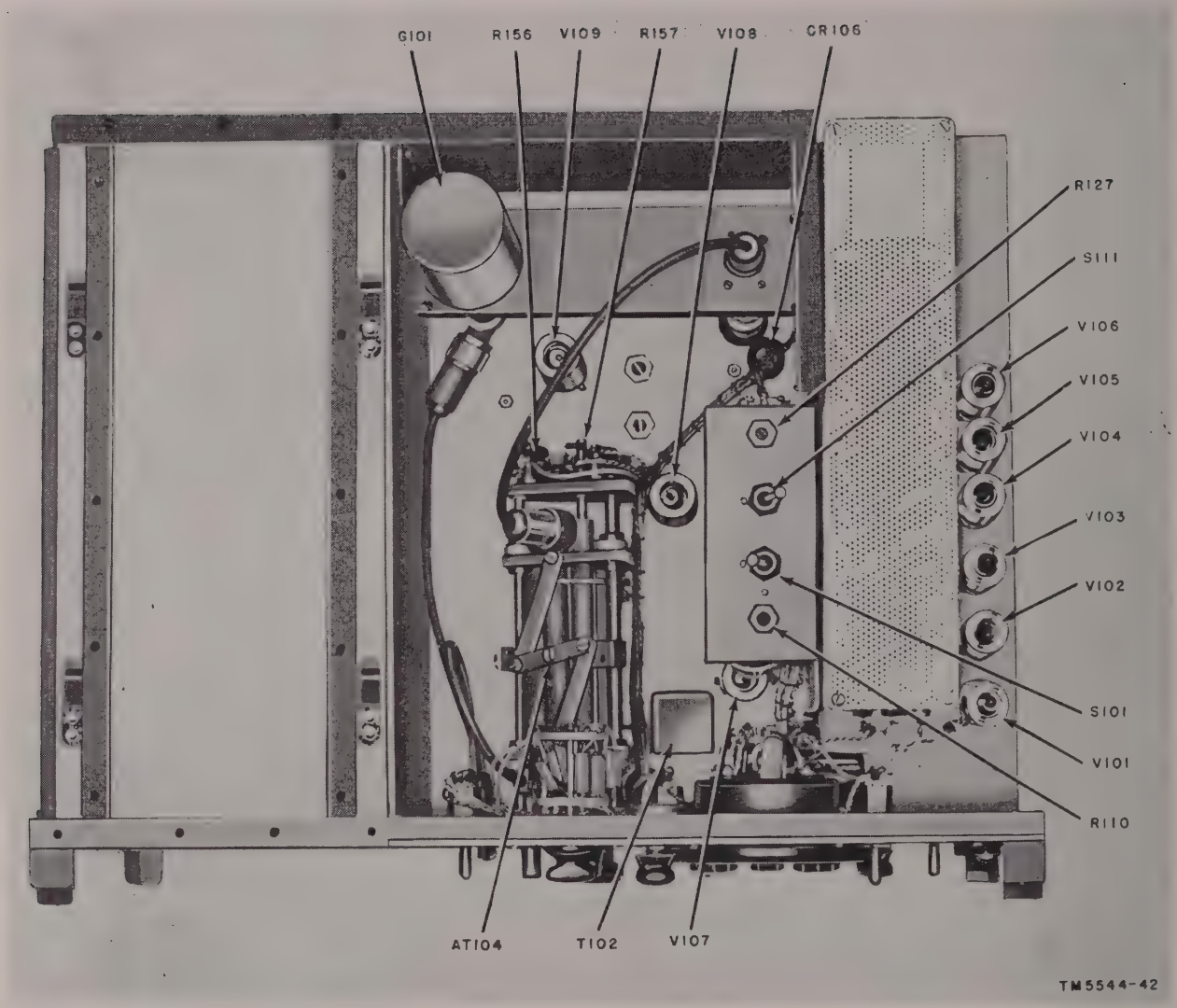


Figure 42. Main unit, top view, location of parts.

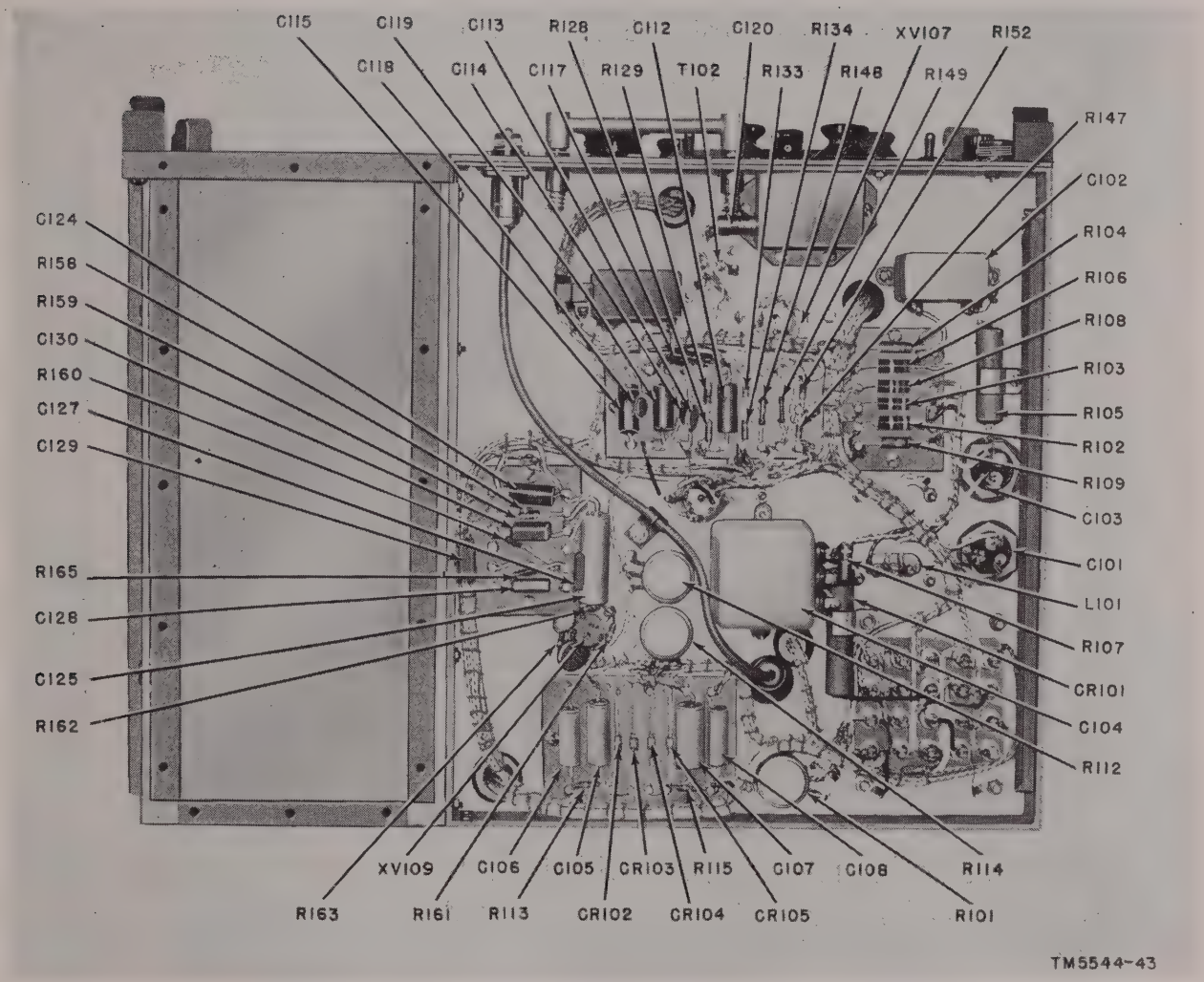


Figure 43. Main unit, bottom view, location of parts.

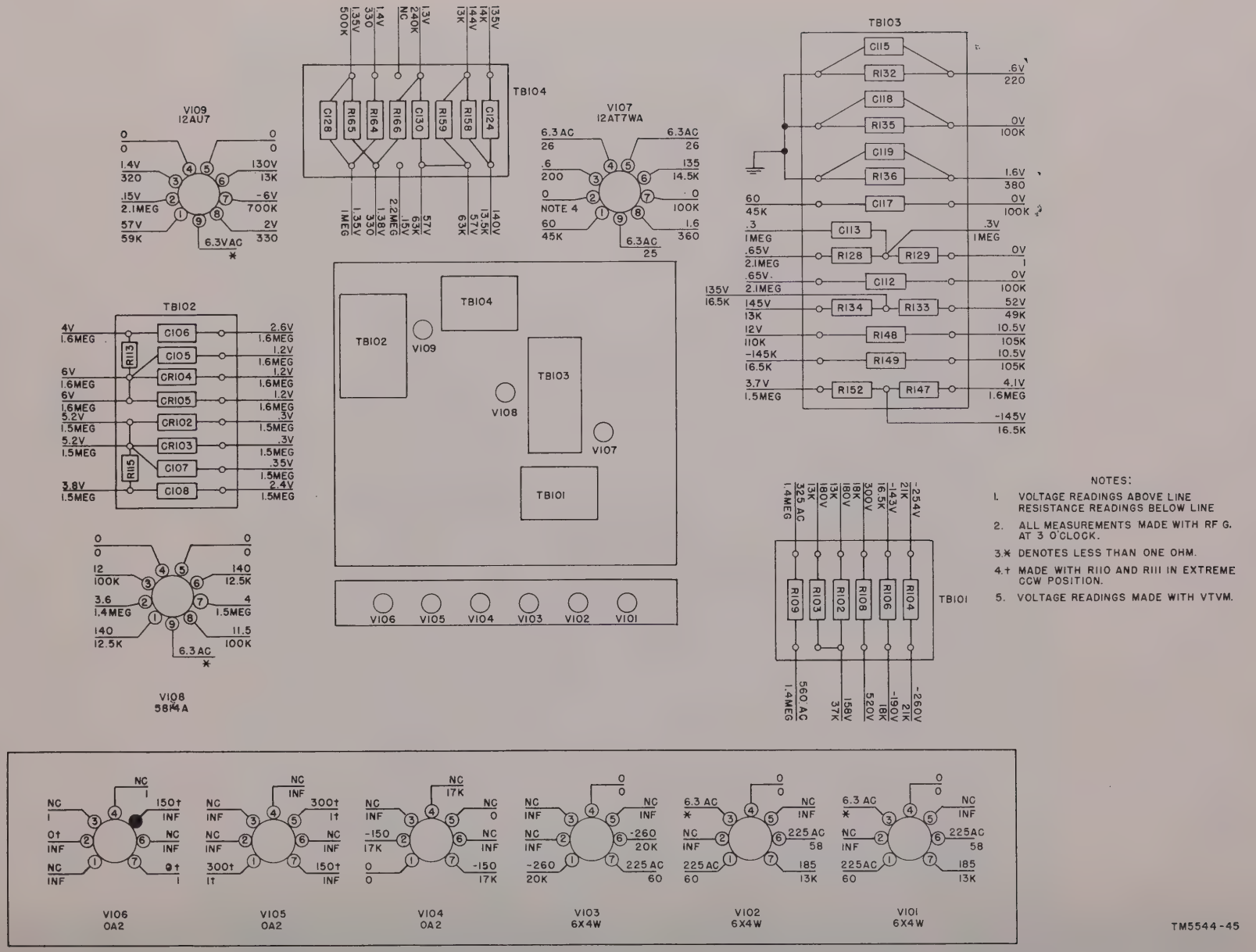


Figure 44. Main unit, tube socket and terminal boards, voltage and resistance diagram.

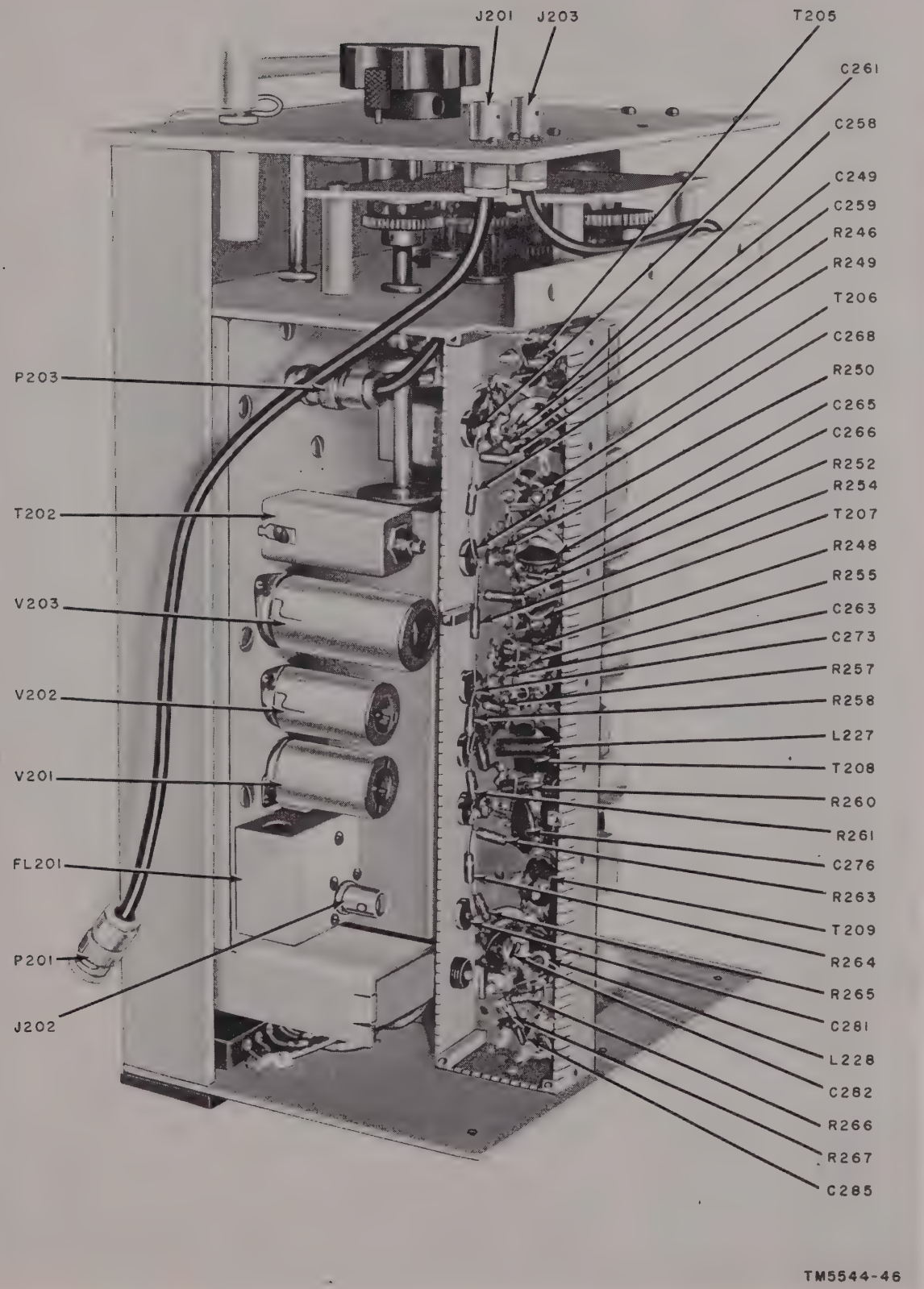


Figure 45. Lf tuner, right side, location of parts.

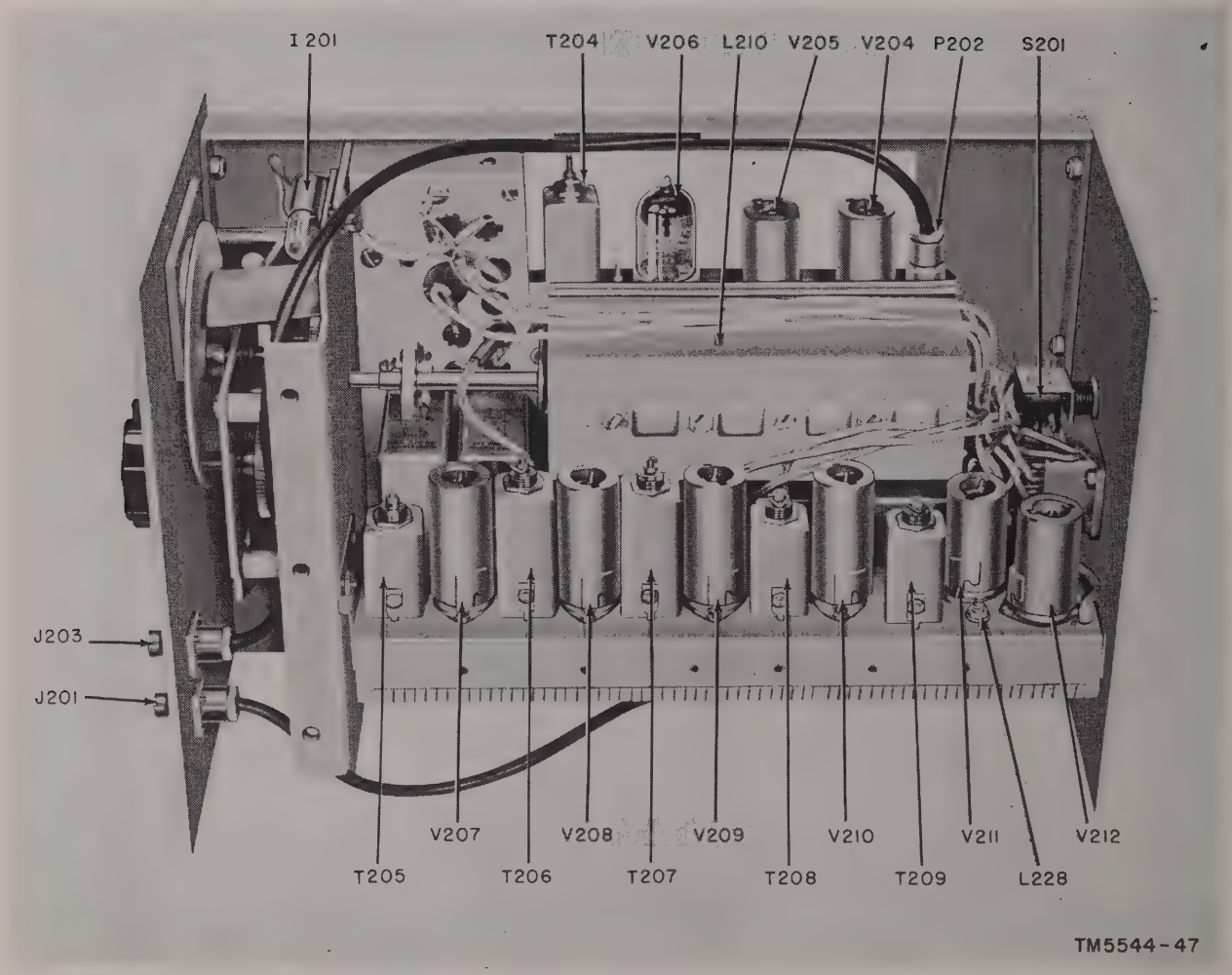


Figure 46. Lf tuner, top view, location of parts.

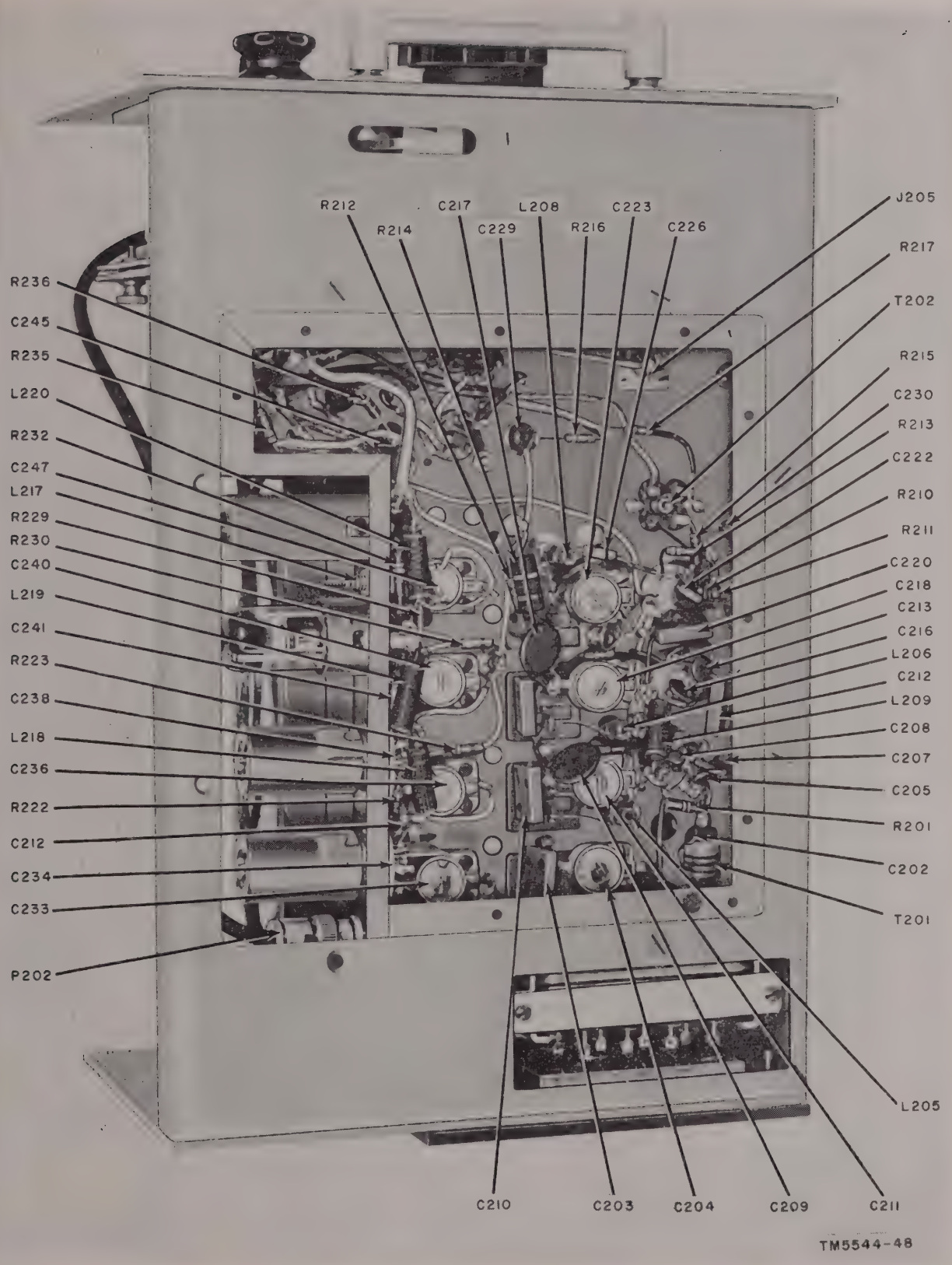


Figure 47. Lf tuner, left side, location of parts.

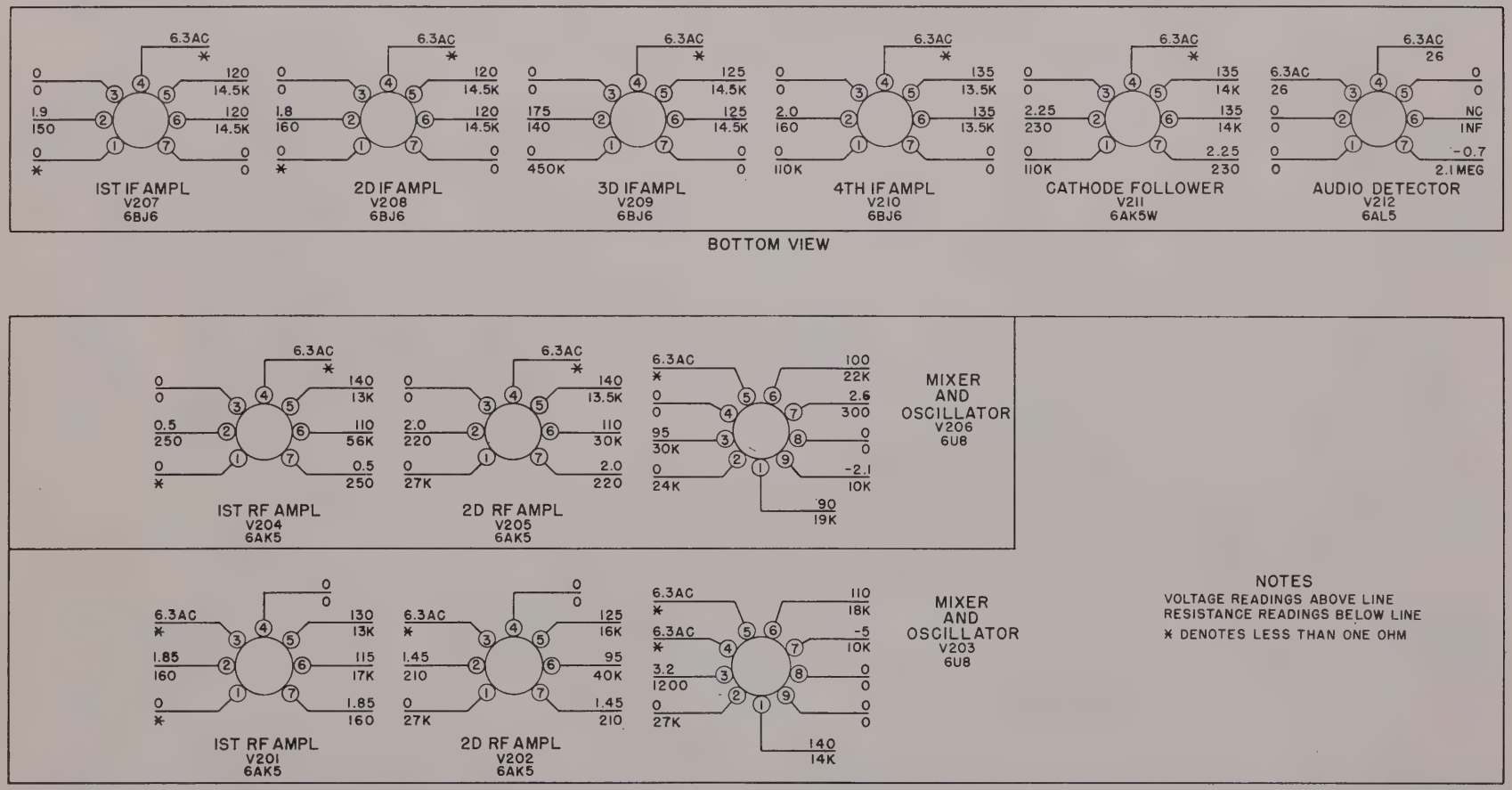


Figure 48. Lf tuner, tube sockets, voltage and resistance diagram.

78. DC Resistances of Transformers and Coils

The dc resistances of transformer windings and the coils are listed below. Those windings and coils with resistances of less than 1 ohm are not included.

Transformer or coil	Terminals	Ohms
L101	1–3	71
	2–3	71
T101	1–2	2.1
	3–5	2.88
	6–8	2.88
	11–12	1,050
	15–17	124
T102	1–2	1,450
	3–4	57
T208	3 4	100,000

79. Signal Substitutions

a. General. Signal substitution requires a source of audio, IF, and RF signals. In addition, a headset supplied with the test set is used to listen to the signals. A multimeter and a tube tester are needed to isolate the defective part after the faulty stage has been indicated by signal substitution. The equipment listed in paragraph 75 is suitable for this purpose. In the tests indicated, ground one side of the signal generator output to the receiver chassis and connect the other side to the receiver point as directed. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. If possible, compare the signal output with that of a test set known to be in good condition. Misalinement of one or more stages of the receiver will cause reduced output. Misalinement of the local oscillator may prevent the tuner from operating. When the trouble is localized to a stage, first test the tube and then measure the voltages. Finally measure the resistance at the tube socket terminals. Leaky capacitors can cause trouble but may check good with the voltage off. Discount a suspected leaky capacitor and replace it with one of equal value. Trouble in a circuit or stage sometimes may not cause changes in voltage and resistance measurements at the tube socket. The instructions included in this paragraph are merely a guide and should suggest other procedures such as voltage and resistance measurements on individual parts.

b. Signal Substitution Charts, Lf Tuner. Directions for signal substitution are contained in the following charts. Each chart contains specific instructions for a particular section of the tuner, such as the audio section, the IF section, and the low-band or high-band RF section. If the items listed in the possible trouble column are not at fault, make voltage and resistance measurements to locate the defective components. Apply the signal indicated in the signal frequency column. If an audio note is not heard in the headset, trouble is indicated. This applies to all the following charts. Connect the tuner to the main unit; use the alinement harness so that the test points will be available.

(1) *IF chart.* Use the signal generator with 400-cps modulation. Set the RF. GAIN and VOLUME controls on the main unit fully clockwise.

Signal frequency (mc)	Connection	Possible trouble
10.7	Junction of R266 and L228.	Defective headset, audio section in main unit, V212, or open R267, R268, C284.
10.7	V211, cathode follower grid, pin 1.	Defective V211 or open R266, L228.
10.7	V210, fourth IF plate, pin 5.	Defective T209, open R263, or shorted C277.
10.7	V210, fourth IF grid, pin 1.	Defective V210, open R260, or shorted C276.
10.7	V209, third IF plate, pin 5.	Defective T208, open R256 and R257 or shorted C271.
10.7	V209, third IF grid, pin 1.	Defective V209, open R255, or shorted C270.
10.7	V208, second IF plate, pin 5.	Defective T207, open R252, or shorted C266.
10.7	V208, second IF grid, pin 1.	Defective V208, open R250, or shorted C265.
10.7	V207, first IF plate, pin 5.	Defective T206, open R246, or shorted C259.
10.7	V207, first IF grid, pin 1.	Defective V207, open R243, R244, R218, or shorted C258, open C256.
10.7	V203, mixer plate, pin 1.	DefectiveT202, S202, K201, K202, T205, J205, P203, open R215, R217, or shorted C230.

(2) *RF chart.* When it has been determined by the tests in *a* above that the

trouble is not in the IF section, use the following chart. Use the signal generator with 400-cps modulation. First check the low RF band and place the FREQUENCY RANGE control on the 20—70-mc range. Then check the high RF band and place the control on the 70—220-mc range. In each case, tune the tuner to the frequency of the signal generator.

Signal frequency (mc)	Connection	Possible trouble
40	V203A, mixer grid, pin 2.	Oscillator V203B not operating, defective V203A, open R211, or shorted C211.
40	V202, second RF plate, pin 5.	Open L203C, L206, C220, R210; or shorted C217, C218, 219.
40	V202, second RF grid, pin 1.	Defective V202; open R206, R208, R209; or shorted C213, C214, C215.
40	V201, first RF plate, pin 5.	Open L203B, L204, C212, R205; or shorted C209, C210, C211.
40	V201, first RF grid, pin 1.	Defective V201; open R202, R203, R204; or shorted C205, C206, C207.
40	J201 on front panel	Defective J201, P201, J202, FL201, T201; open R201, L203A, L204; or shorted C203, C204.
150	V206A, mixer grid, pin 2.	Oscillator V206B not operating, defective V206A, T204; open R228, R229, R232; or shorted C242, C243, C244, C250.
150	V205, second RF plate, pin 5.	Open L210C, L214, L215, C241, R227, or shorted C239, C240.
150	V205, second RF grid, pin 1.	Defective V205; open R224, R225, R226; or shorted 238A, B, C.
150	V204, first RF plate, pin 5.	Open L210B, L212, L213, C237, R222; or shorted C235, C236.
150	V204, first RF plate, pin 1.	Defective, V204 open R219, R221, R222, or shorted C234A, B, C.
150	J203 on front panel	Defective J203, P202, J204, T203, open L210A, L211, or shorted C233.

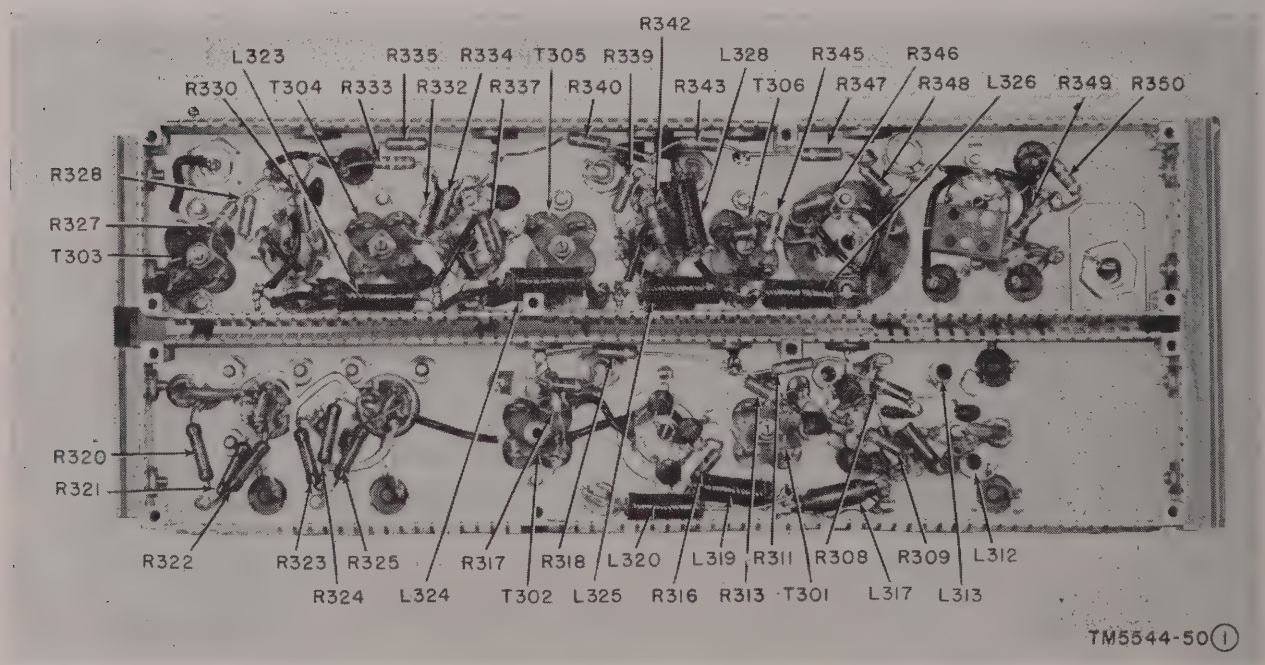


Figure 49. Hf tuner, right side, location of parts.

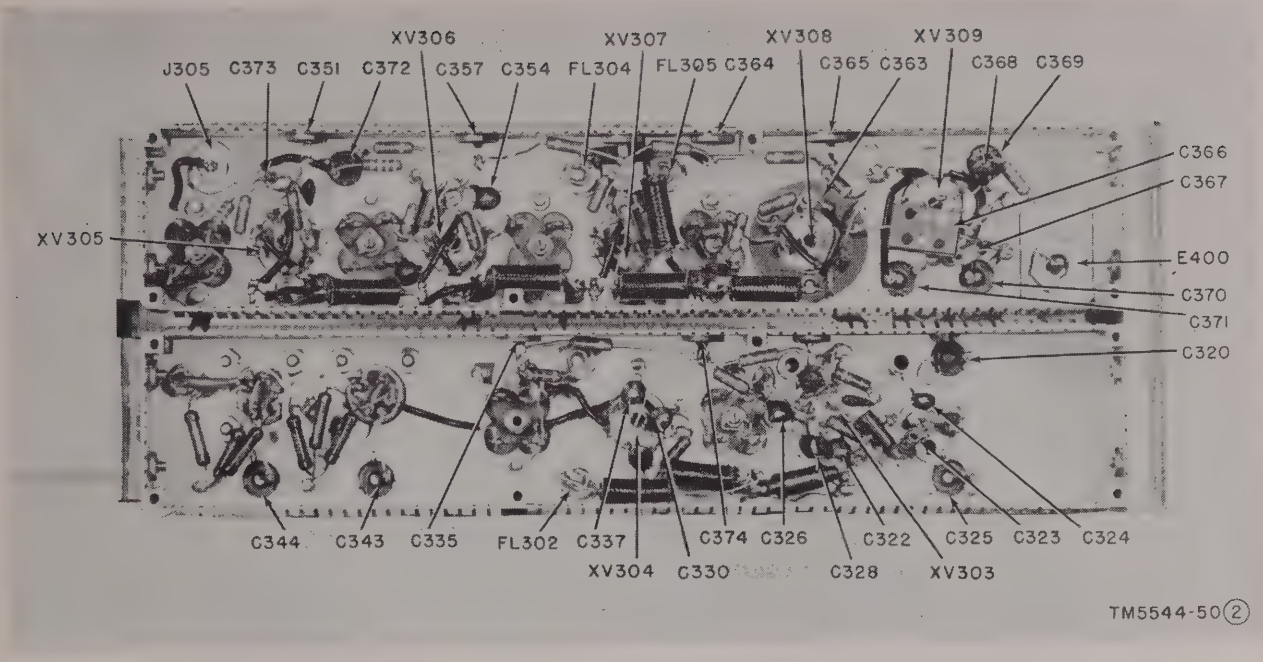


Figure 49—Continued.

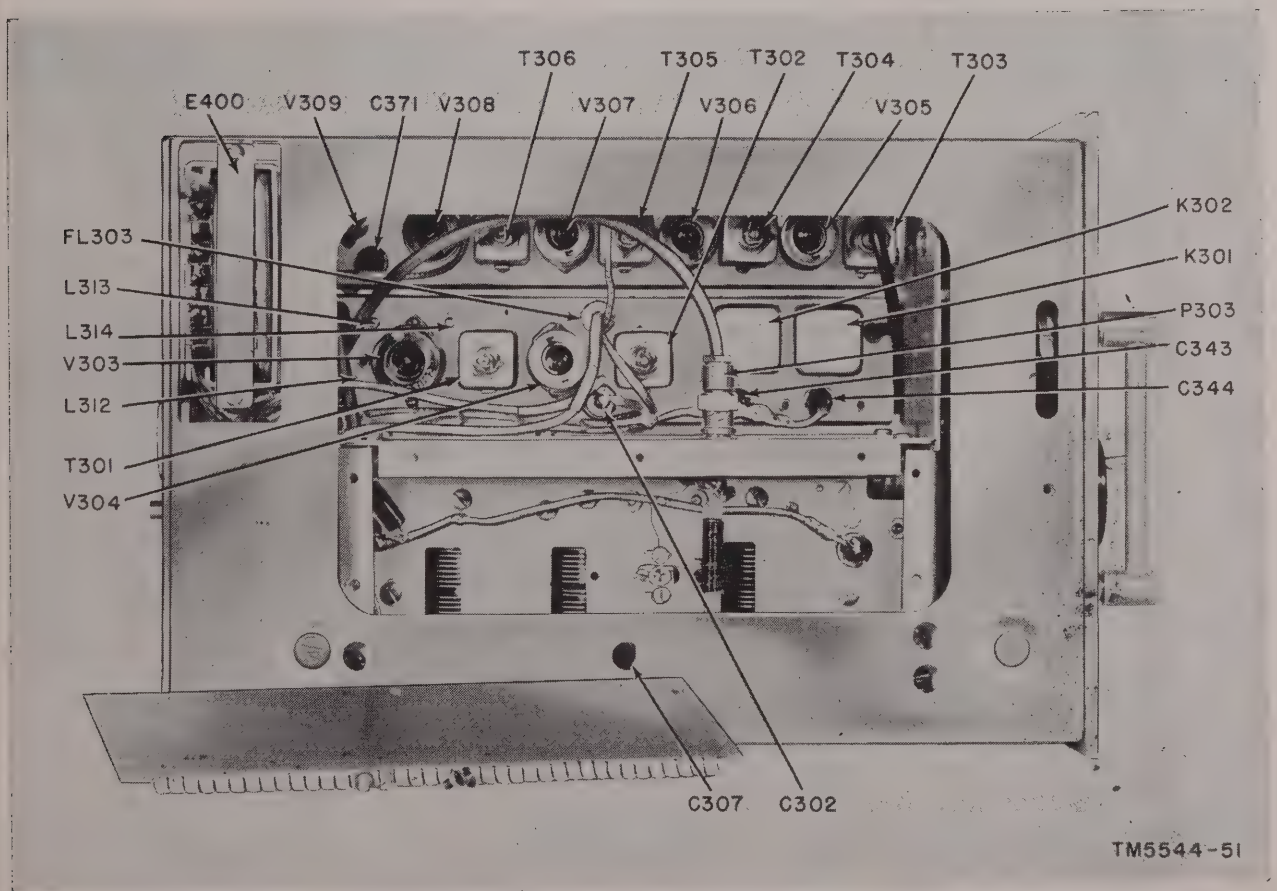


Figure 50. Hf tuner, left side, location of parts.

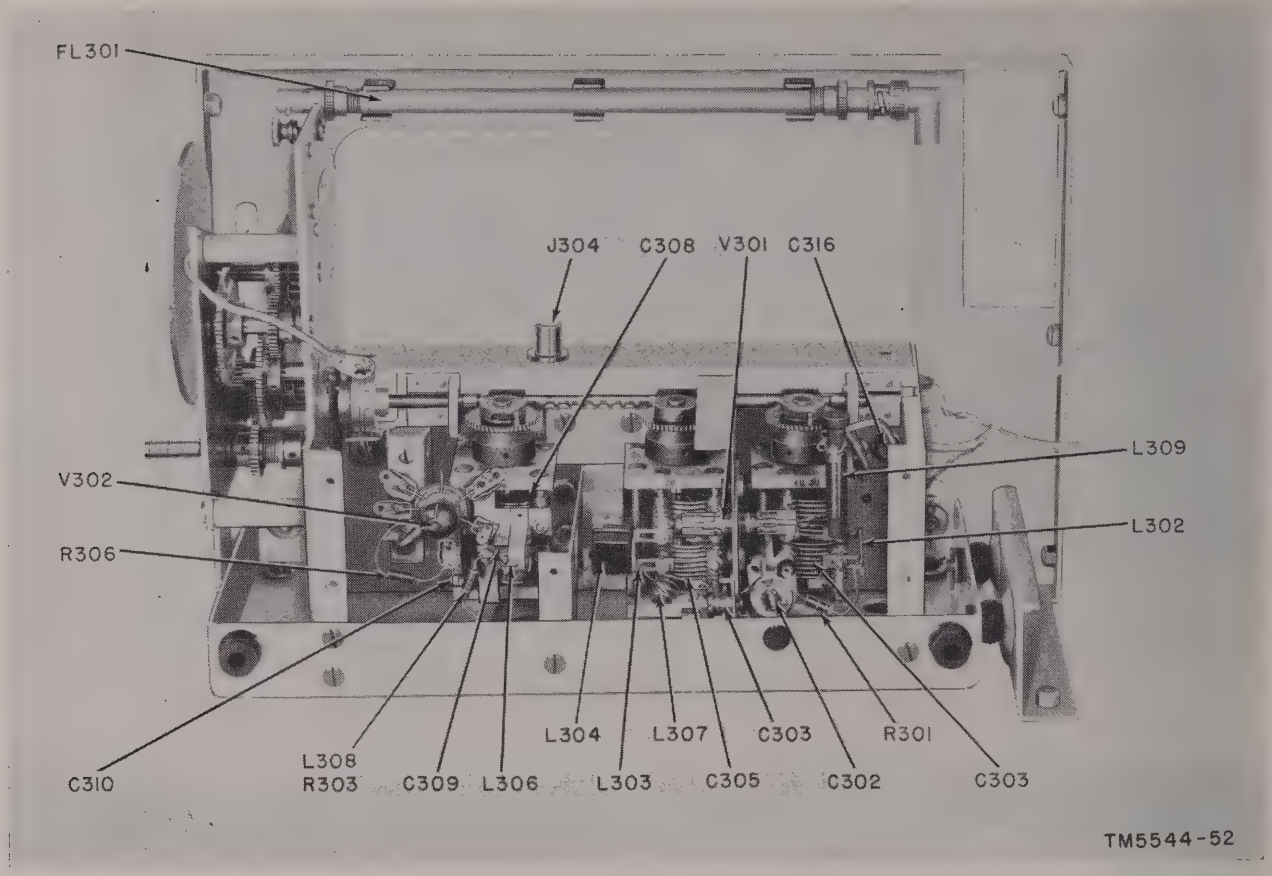


Figure 51. Hf tuner, RF assembly, location of parts.

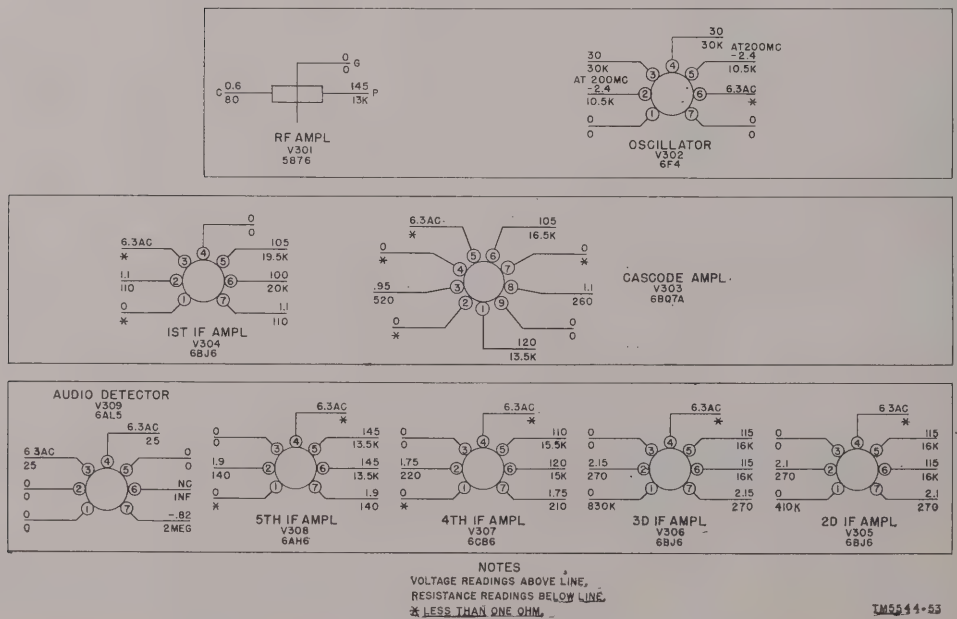


Figure 52. Hf tuner, tube sockets, voltage and resistance diagram.

c. Signal Substitution Charts, Hf Tuner. Connect the hf tuner to the main unit using the alinement harness so that the test points will be available.

(1) *IF chart.* Use the signal generator with 400-cps modulation. Set the RF. GAIN and VOLUME controls on the main unit fully clockwise.

Signal frequency (mc)	Connection	Possible trouble
42	Junction of C366 and C367.	Defective headset, audio section in main unit, V309, open R349, R350, C369, or shorted C368.
42	V308, fifth IF grid, pin 1.	Defective V308, open R346, R348, L322, C366; or shorted C363A, C363C, C365.
42	V307, fourth IF plate, pin 5.	Defective T306; open R342, R345; or shorted C359.
42	V307, fourth IF grid, pin 1.	Defective V307, open R340, or shorted C358.
42	V306, third IF plate, pin 5.	Defective T305, open R337, or shorted C354.
42	V306, third IF grid, pin 1.	Defective V306, open R334, or shorted C353
42	V305, second IF plate, pin 5.	Defective T304, open R330, R332, R333; or shorted C348.
42	V305, second IF grid, pin 1.	Defective V305, open R327, R328; or shorted C347.
42	V304, first IF plate, pin 5.	Defective T302, T303, K301, K302, P304, J305; open R317; or shorted C332.
42	V304, first IF grid, pin 1.	Defective V304, open R316, or shorted C330.
42	V303B, grounded grid amplifier plate, pin 6.	Defective T301, open R313, or shorted C328.
42	V303A, cascode driver plate, pin 1.	Defective V303; open R309, R310, C325, L314; or shorted C326, C333.
42	V303A, cascode driver grid, pin 2.	Defective V303; open R308, C324, L313; or shorted C322, C323.
42	CR301, mixer plate	Defective 1N21B, J304, P303; open L304, L305, L312, C307.
300	V301, RF plate	Oscillator V302 not operating, open L303, L307, or shorted C305, C306, C313.
300	V301, RF grid	Defective V301.
300	J301 on front panel	Defective J301, P301, J302, J303, P302, FL301, open L301, L302, R301, or shorted C301, C302.

(2) *RF chart.* When it has been determined by the above tests that the trouble is not in the IF section, use the following chart. In each case, tune the tuner to the frequency of the signal generator.

80. Replacement of Parts

Note. Several parts used in the test set have smaller tolerances than those used in most radio equipment. All resistors which are part of attenuators AT101 through AT104 and resistors R137, R138, R141, R142, R148, R149, R150, R153, and R157, are precision parts. Resistors R237 through R242 in the lf tuner and R320 through R325 in the hf tuner are also precision parts. If these parts require replacement, use the *exact* value of the part removed. If even slightly different values are used, the accuracy of the measuring set will be affected.

a. To remove attenuator AT104—

(1) Remove the main unit from its dust cover.
(2) Disconnect the two coaxial cable connections to AT104 at the front and rear.
(3) Loosen the control knob set screw and remove the knob.
(4) Remove the three screws on the front panel which hold AT104.
(5) Remove the two screws on the rear bracket.
(6) Move the attenuator back, away from the front panel, and lift it out.

b. To remove attenuator AT103—

(1) Disconnect connector adapter P105 from relay K102.
(2) Disconnect connector adapter P108 from relay K103.
(3) Remove attenuator AT103.
(4) Disconnect connector adapters P105 and P108 from AT103.

c. To remove relays K102 and K103 or noise generator G101—

(1) Disconnect the three coaxial cable connections to the relays and noise generator.

(2) Remove the four No. 4–40 screws that hold the mounting plate.
(3) Remove the two No. 6–32 screws that hold the noise generator bracket.
(4) Unsolder the three leads and tag them for identification.
(5) Unscrew the coaxial connector that joins the noise generator to relay K102.
(6) Lift out the noise generator.
(7) Remove the four No. 6–32 mounting screws that hold relay K102 on the mounting plate.
(8) Remove relay K102.
(9) Remove the four No. 6–32 mounting screws that hold relay K103 on the mounting plate.
(10) Remove relay K103.

d. To remove the gear assembly in the lf tuner—

(1) Loosen the setscrew of the FREQUENCY RANGE knob and remove the knob.
(2) Loosen the setscrew of the TUNING knob and remove the knob.
(3) Remove the six No. 6–32 flathead screws on the front panel.
(4) Remove three No. 6–32 flathead screws on the right side.
(5) Disconnect the two cables which couple the front panel connectors to the tuner chassis.
(6) Move the front panel aside.
(7) Remove three No. 6–32 binder head screws that hold the gear assembly rear plate to the tuner chassis.
(8) Remove two No. 4–40 binder head screws and nuts that hold the rear plate to the IF chassis bracket.
(9) Pull the gear assembly forward to uncouple the Oldham coupler.
(10) Remove the gear assembly.

e. To remove the gear assembly in the hf tuner—

(1) Loosen the setscrew of the TUNING knob and remove the knob.
(2) Remove the coaxial connector from the low pass filter FL301 behind the front panel.
(3) Remove the six No. 6–32 flathead screws from the front panel.
(4) Remove the front panel.
(5) Remove the two No. 6–32 binder head screws on the left side and the two No. 6–32 binder head screws on the right side that hold the gear assembly rear plate to the tray.
(6) Remove the two No. 6–32 binder head screws that hold the rear plate to the tuner chassis.
(7) Pull the gear assembly forward to uncouple the Oldham coupler.
(8) Remove the gear assembly.

f. To replace an electrometer detector unit in either tuner—

(1) Unsolder and tag the leads.
(2) Remove the No. $\frac{3}{8}$–32 nut.
(3) Remove the two No. 4–40 screws that hold the top bracket.
(4) Lift off the bracket.
(5) Lift out the electrometer detector unit.

Section III. CALIBRATING AND ALINEMENT

81. Test Equipment Required

The following test equipment is required for calibration and alinement of Radio Interference Measuring Set AN/URM–7.

Item	Technical manual	Common name
Signal Generator TS–497B/U.	TM 11–5030A	Signal generator
Electronic Multimeter TS–505A/U.	TM 11–5511A	Vtvm

82. Filament Voltages and ±300 Volts Adjustments

Make the following adjustments in the power supply section of the main unit before proceeding with the alinement procedures.

a. ±300 Volts.

(1) Set switch S101 at +300.
(2) Connect the positive lead of the vtvm to the center terminal of R111 and connect the negative lead to chassis ground.

(3) Set the main-unit power switch at ON.

(4) Adjust R111 for a 300-volt indication on the vtvm. Remove the vtvm leads.

(5) Set switch S101 at —300.

(6) Connect the negative vtvm lead to the center terminal of R110 and connect the positive lead to chassis ground.

(7) Adjust R110 for a 300-volt indication on the vtvm.

b. Filament Voltage Balance Adjustment.

(1) Set the vtvm to measure ac volts. Connect one lead to chassis ground and the other alternately to terminals 13 and 14 of transformer T101.

(2) Adjust R101 until the voltages between each terminal and ground are equal. Disconnect the leads.

c. Electrometer Filament Voltages.

Caution: If these adjustments are not made properly, the electrometer unit may become damaged.

(1) Set the vtvm to measure dc volts.

(2) Turn resistor R112 fully clockwise.

(3) Connect the leads of the vtvm to the contacts of capacitor C106, observing proper polarity.

(4) Adjust R112 for a 1.25-volt indication on the vtvm.

(5) Turn R114 fully clockwise, move the vtvm leads to C108, and adjust R114 for a 1.25-volt indication on the vtvm.

83. IF Alinement

a. Lf Tuner.

(1) Connect the lf tuner to the main unit; use the alinement harness.

(2) Set the main unit power switch to ON and allow the tuner to warm up for about an hour.

(3) Set the signal generator to 10.7 mc, with 30 per cent modulation at 400 cycles.

(4) Connect the signal generator output to terminal 1 of IF transformer T205 and the ground lead to the receiver chassis.

(5) Set the front panel controls on the main unit as follows:

Control	Setting
Function switch	CW. AVERAGE.
RF. GAIN control	Fully clockwise.
VOLUME control	Fully clockwise.
SIGNAL INPUT ATTENUATOR	20.
CALIBRATION switch	SERIES.
IMPULSE GENERATOR switch	OFF.

(6) Set the FREQUENCY RANGE control to the 20–70 MEGACYCLES range on the lf tuner.

(7) Adjust the attenuator on the signal generator so that the audio signal is heard in the headset and an indication is seen on the panel meter.

Note. As the receiver is brought into alinement, decrease the signal generator output to keep output signal at a comfortable level.

(8) Adjust the slotted screw at the bottom of T209, for maximum output.

(9) Adjust the slotted screw at the bottom of T208 for maximum output.

(10) Adjust the slotted screws at the top and bottom of T207 for maximum output.

(11) Adjust the slotted screws at the top and bottom of T206 for maximum output.

(12) Adjust the slotted screw at the bottom of T205 for maximum output.

(13) Close switch S111 on the main unit.

(14) Adjust the signal generator output so that the panel meter reads approximately 14.

(15) Adjust L228 for maximum. Decrease the signal generator input to keep the meter at 14.

(16) Repeat (8) through (12) above to obtain maximum output.

b. Hf Tuner.

(1) Connect the hf tuner to the main unit; use the alinement harness.

(2) Set the main unit power switch to ON and allow the tuner to warm up for about an hour.

(3) Set the signal generator to 42 mc, with 30 per cent modulation at 400 cycles.

(4) Connect the signal generator output to the center pin of plug P303.

(5) Set the front panel controls on the main unit as shown in *a*(5) above.

(6) Adjust the attenuator on the signal generator so that the audio signal is heard in the headset and is an indication seen on the panel meter. As the receiver is brought into alinement, decrease the signal generator output to keep the signal at a comfortable level.

(7) Adjust the slotted core of L322 for maximum output.

(8) Adjust the slotted screws at the top and bottom of T306 for maximum output.

(9) Adjust the slotted screws at the top and bottom of T305 for maximum output.

(10) Adjust the slotted screws at the top and bottom of T304 for maximum output.

(11) Adjust the slotted screw at the top of T303 for maximum output.

(12) Adjust the slotted screw at the top of T302 for maximum output.

(13) Adjust the slotted screws at the top and bottom of T301 for maximum output.

(14) Adjust the slotted core of L314 for maximum output.

(15) Adjust the slotted core of L313 so that cascode amplifier V303 does not oscillate.

(16) Adjust the slotted core of L312 for maximum output.

(17) Repeat the steps given in (7) through (16) above to obtain maximum output.

84. RF and Oscillator Alinement

a. Lf Tuner.

(1) Connect the lf tuner to the main unit; use the alinement harness.

(2) Set the main unit power switch to ON and allow a warmup for at least an hour.

(3) Set the front panel controls on the main unit as follows:

Control	Setting
Function switch	CW. AVERAGE.
RF. GAIN control	Fully clockwise.
VOLUME control	Fully clockwise.
SIGNAL INPUT ATTENUATOR	20.
CALIBRATION switch	SERIES.
IMPULSE GENERATOR switch	OFF.

(4) Set the FREQUENCY RANGE control to the 20–70 MEGACYCLES range on the front panel of the lf tuner.

(5) Set the signal generator to 70 mc with 30 per cent modulation at 400 cycles.

(6) Connect the signal generator output to the input lead of RF transformer T201 and the ground lead to the chassis.

(7) Adjust the slotted core of L208 so that the best tracking is obtained as the signal generator and tuner are varied from 70 mc down to 20 mc.

(8) Adjust the slotted core of L207 so that the dial reads 20 mc at peak output with the signal generator set at 20 mc.

(9) Tune the signal generator to 70 mc.

(10) Adjust C226 so that the dial reads 70 mc at peak output.

(11) Adjust the slotted screw at the top of T202 for maximum output.

(12) Adjust C219, C211, and C204 for maximum output.

(13) Tune the signal generator and the TUNING control to 20 mc.

(14) Adjust the slotted core of L206, L205, and L204 for maximum output.

(15) Repeat (7) through (14) above to obtain maximum output.

(16) Set the FREQUENCY RANGE control to the 70–220 MEGACYCLES range on the front panel of the lf tuner.

(17) Connect the RF cable from the main unit to the upper coaxial jack on the lf tuner.

(18) Set the signal generator to 200 mc with 30 per cent modulation at 400 cycles.

(19) Connect the signal generator output to the input lead of RF transformer

T203 and the ground lead to the receiver chassis.

(20) Adjust the slotted core of L217 so that the best tracking is obtained as the signal generator and tuner are varied from 200 mc down to 70 mc.

(21) Squeeze L216 to obtain maximum output at 70 mc.

(22) Tune the signal generator and set the TUNING control at 200 mc.

(23) Adjust C246 to obtain maximum output.

(24) Adjust the slotted screw at the top of T204 for maximum output.

(25) Adjust C240, C236, and C233 for maximum output.

(26) Tune the signal generator and the TUNING control at 70 mc.

(27) Squeeze L215, L213, and L211 to obtain maximum output.

(28) Repeat (20) through (27) above to obtain maximum output.

b. Hf Tuner.

(1) Connect the hf tuner to the main unit; use the alinement harness.

(2) Set the main unit power switch to ON and allow a warmup for at least an hour.

(3) Set the front panel controls on the main unit as shown in *a*(3) above.

(4) Set the signal generator to 380 mc, with 30 per cent modulation at 400 cycles.

(5) Connect the signal generator output to the high end of L301 and the ground lead to the chassis.

(6) Set the TUNING control to 380.

(7) Adjust C309 for maximum output.

(8) Tune the signal generator and the TUNING control to 200 mc.

(9) Move L306 closer or farther from L304 to obtain maximum output.

(10) Move L303 closer or farther from L304 to obtain maximum output.

(11) Move L302 closer or farther from L201 to obtain maximum output.

(12) Tune the signal generator and the TUNING control to 300 mc.

(13) Adjust C307 for maximum output.

(14) Tune the signal generator and the TUNING control to 380 mc.

(15) Adjust C306, C302, and C301 for maximum output.

(16) Repeat (7) through (15) above to obtain maximum output.

CHAPTER 6
FINAL TESTING

85. Purpose of Final Testing

The tests outlined in this chapter are designed to measure performance capability of a repaired equipment. Equipment that meets the minimum standards will furnish satisfactory operation, equivalent to that of new equipment.

86. Test Equipment Required

Signal Generator TS–497/URR is required for final testing.

87. Dial Calibration Accuracy

a. With the lf tuner plugged in, connect a cable, made up of RF Cable RG–5/U with a type N male connector on each end, from the RF output jack on the signal generator to the SIGNAL INPUT jack on the main unit.

b. Set the controls as described in paragraph 20*a*(3).

c. Set the function switch at CW. AVERAGE.

d. Turn the RF. GAIN control fully clockwise.

e. Plug the lf tuner into the main unit.

f. Set the FREQUENCY RANGE control and the signal generator at 20 mc.

g. Adjust the attenuator on the signal generator to obtain an on-scale reading on the panel meter of the main unit.

h. Adjust the TUNING control on the lf tuner to obtain the maximum reading on the panel meter. If necessary, adjust the attenuator on the signal generator to keep the reading on scale.

i. Read the frequency on the lf tuner dial. This must be within 2 percent of the signal generator frequency.

j. Repeat *h* through *i* above, increasing the signal generator frequency in steps of 10 mc.

k. Repeat *f* through *j* above, with the hf tuner connected in the main unit and starting at 200 mc.

88. Linearity

a. Connect a cable as described in paragraph 87*a*.

b. Set the controls as described in paragraph 20*a*(3).

c. Set the SIGNAL INPUT ATTENUATOR to 60.

d. Set the signal generator attenuator for a 100,000-microvolt output.

e. Adjust the RF. GAIN control on the main unit to produce a 0–db indication on the panel meter.

f. Increase the signal generator output to 17,780 microvolts and record the panel meter reading.

g. The panel meter must read 5 db ±1 db.

h. Repeat the procedure given in *f* above, increasing the signal generator output three times to 31,620 μv, 56,230 μv, and 100,000 μv in succession.

i. The panel meter must increase 5 db ±1 db at each step.

j. Repeat the procedures given in *a* through *i* above, with the lf tuner plugged in.

89. Cw Sensitivity

a. Connect the lf tuner in the main unit and tune it to 20 mc.

b. Connect a 50-ohm 20-db attenuator to the SIGNAL INPUT jack on the main unit.

c. Connect a cable (par. 87*a*) between the signal generator and the 50-ohm 20-db attenuator.

d. Set the controls as described in paragraph 20*a*(3).

e. Set the function switch at CW. AVERAGE.

f. Set the SIGNAL INPUT ATTENUATOR to 0 CW ONLY.

g. Set the CALIBRATION switch to SERIES.

h. Set the signal generator output at 10 microvolts.

i. Adjust the RF. GAIN control to produce a deflection of 10 microvolts on the panel meter.

j. Reduce the signal generator output to 0 microvolts.

k. The meter reading must be less than 2 microvolts.

l. Repeat *a* through *k* above at 50, 80, 110, 140, 170, 200 mc frequencies.

m. Replace the lf tuner with the hf tuner.

n. Set the signal generator and tuner at 200 mc.

o. Repeat the procedures given in *b* through *j* above.

p. The reading must be less than 5 microvolts.

q. Repeat *n* through *p* above at 235, 270, 305, 340, 375, 400 mc.

90. Impulse Noise Sensitivity

a. Connect the lf tuner in the main unit with the frequency set at 20 mc.

b. Connect a cable as described in paragraph 87*a*.

c. Set the controls as described in paragraph 20*a*(3).

d. Adjust the RF. GAIN control to produce a 0–db indication on the panel meter.

e. Set the IMPULSE GENERATOR switch at ON and adjust the IMPULSE GENERATOR output controls to produce a 20-db indication on the panel meter.

f. The IMPULSE GENERATOR output control settings must be less than 54 on the 20- to 70-mc band and less than 48 db on the 70- to 220-mc band.

g. Repeat *a* through *f* above at 50, 80, 110, 140, 170, 200 mc.

h. Connect the hf tuner in the main unit.

i. Set the frequency at 200 mc.

j. Repeat the procedures given in *b* through *e* above.

k. The output control settings must be less than 50.

l. Repeat *b* through *e* above at 235, 270, 305, 340, 375, 400 mc frequencies.

m. The attenuator setting must be less than 50.

91. Image Rejection

a. Connect the lf tuner in the main unit.

b. Connect a cable as described in paragraph 87*a*(3).

c. Set the controls as described in paragraph 20*a*(3).

d. Set the signal generator at 20 mc.

e. Set the signal generator attenuator at 10 μv.

f. Set the TUNING control on the lf tuner at 20 mc.

g. Set the SIGNAL INPUT ATTENUATOR and the RF. GAIN control to produce an on-scale reading on the panel meter for a reference reading.

h. Set the signal generator output TUNING control to 21.4 mc above the TUNING control setting.

i. Increase the signal output until the reference reading (*g* above) is reached.

j. The signal generator output must be greater than 10,000 μv (more than a 60-db increase).

k. Repeat *d* through *i* above at 50, 80, 110, 140, 170, 200 mc.

l. The signal generator output must be increased more than 60 db up to 70 mc and more than 36 db from 70 to 200 mc.

m. Connect the hf tuner in the main unit.

n. Repeat *d* through *i* above at 200, 235, 270, 305, 340, 375, 400 mc except set the signal generator output at 84 mc above the TUNING control setting.

o. The signal generator output must be increased more than 35 db up to 350 mc and more than 30 db from 350 to 400 mc.

92. IF Rejection

a. Connect the IF tuner in the main unit.

b. Connect a cable as described in paragraph 87*a*.

c. Set the controls as described in paragraph 20*a*(3).

d. Set the TUNING control and the signal generator at 20 mc.

e. Set the attenuator on the signal generator at 10 μv.

f. Set the SIGNAL INPUT ATTENUATOR and the RF. GAIN control to produce an on-scale reference reading on the panel meter.

g. Set the signal generator at 10.7 mc.

h. Increase the signal generator output until the reference reading from *f* above is reached.

i. The signal generator output must be greater than 10,000 μv (more than a 60-db increase).

j. Repeat *d* through *i* above for 50, 80, 110, 200 mc.

k. Connect the hf tuner to the main unit.

l. Repeat *d* through *i* above for 200, 235, 270, 305, 340, 375, and 400 mc, except in *g* above set the signal generator at 42 mc.

93. RF Intermodulation

a. Connect the lf tuner in the main unit and tune it to 20 mc.

b. Set the controls as described in paragraph 20*a*(3).

c. Set the SIGNAL INPUT ATTENUATOR at 0 CW ONLY.

d. Set the function switch at ZERO ADJ.

e. Turn the ZERO ADJ. control to produce a 0-μv indication on the panel meter.

f. Set the function switch at PULSE PEAK.

g. Adjust the RF. GAIN control to produce 0 db on the panel meter.

h. Set the IMPULSE GENERATOR switch at ON.

i. Adjust the IMPULSE GENERATOR output controls to produce a 2-db indication on the panel meter.

j. Note the settings of the output controls and use these as the reference sensitivity.

k. Remove V203 or V206 to disable the local oscillator.

l. Readjust the IMPULSE GENERATOR output controls to produce a 2-db indication on the panel meter.

m. Note the output controls settings. The difference between this reading and the reading in *j* above must be greater than 35 db.

n. Repeat *c* through *m* above at 80, 140, and 200 mc.

o. Connect the hf tuner to the main unit.

p. Repeat *c* through *m* above for 200, 265, 330, and 400 mc, except in *k* above remove V302.

94. Bandwidth

a. Connect the lf tuner to the main unit.

b. Connect a cable as described in paragraph 87*a*.

c. Set the controls as described in paragraph 20*a*(3).

d. Set the signal generator output at 100 microvolts.

e. Set the RF. GAIN control to produce an on-scale reading on the panel meter. Use this reading as a reference.

f. Set the IMPULSE GENERATOR switch to ON.

g. Adjust the IMPULSE GENERATOR output controls to produce the same reference reading as found in *e* above. Note the setting of the controls.

h. The bandwidth (BW) in kc is the signal generator output in microvolts divided by the impulse generator output (above)/1000;

$$BW = \frac{\textit{sine wave } \mu v \textit{ of signal generator setting in step } g.}{1{,}000} \text{ kc}$$

i. The bandwidth must be 80 kc ±10 kc.

j. Connect the hf tuner to the main unit.

k. Repeat *d* through *h* above.

l. The bandwidth must be 350 kc ±50 kc.

CHAPTER 7
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

95. Disassembly

To disassemble the test set—

a. Disconnect the battery power cord from the 24-volt battery and from Motor-Generator PU–388/G.

b. Disconnect the ac cord plugged into the outlet on the motor-generator and remove the second end from the main unit.

*c.*Remove the six-inch RF cord that connects the main unit to the tuner.

d. Remove the RF antenna cable from the antenna and the main unit.

e. Remove the antenna from the tripod.

f. Unplug the headset from the main unit.

g. Remove the four legs from the main unit.

h. Place the main unit in the transit case and fasten the cover.

i. Place the second tuner in its transit case and fasten the cover.

j. Place all the accessories in the transit case and fasten the cover.

k. Fold up the tripod.

l. Place the tripod in the tripod bag and close the zipper.

m. Check the equipment against the table of components (par. 5).

96. Packing for Shipment or Limited Storage

Figure 5 illustrates one method of packing any one of the transit cases. Specific directions for repacking a typical component are as follows:

a. Cushion the transit case on all surfaces with cells or pads fabricated of corrugated fiberboard. Place the cushioned transit case, together with the desiccant, within a close-fitting, corrugated fiberboard box. Seal the entire closure with gummed tape and blunt all corners of the box.

b. Place the boxed set within a moisture-vaporproofed barrier and heat-seal the closure. Place the moisture-vaporproofed transit case within a second close-fitting, corrugated fiberboard box and seal the entire closure with water-resistant tape or adhesive.

c. Overwrap the boxed transit case in waterproof barrier material. Completely seal all joints, seams, and closures with adhesive or other suitable seal equal in moisture resistance to that of the body material.

d. Place the equipment, packaged as described above, within a nailed wooden box lined with a 2-inch thickness of excelsior compacted to 3 pounds per cubic foot. The shipping container should *not* be lined with a waterproof bag. Mark the wooden boxes according to the packaging data in paragraph 13.

e. For oversea shipment only, strap the shipping container in accordance with approved specifications.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

97. General

The demolition procedures outlined in paragraph 98 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

98. Methods of Destruction

Any or all of the methods of destruction given below may be used. The time available will be the major determining factor in most instances when destruction of equipment is undertaken. The tactical situation also will determine in what manner the destruction order will be carried out. In most cases, it is preferable to demolish completely some portions of the equipment rather than partially destroy all the equipment units.

a. Smash. Use sledges, axes, hammers, crowbars, and any other heavy tools available to

smash the units of the test set. Smash the front-panel knobs, dials and meters, the external meter, and the headsets. Because the transit cases will resist smashing, it will be necessary to remove the various units from their cases to smash their interiors.

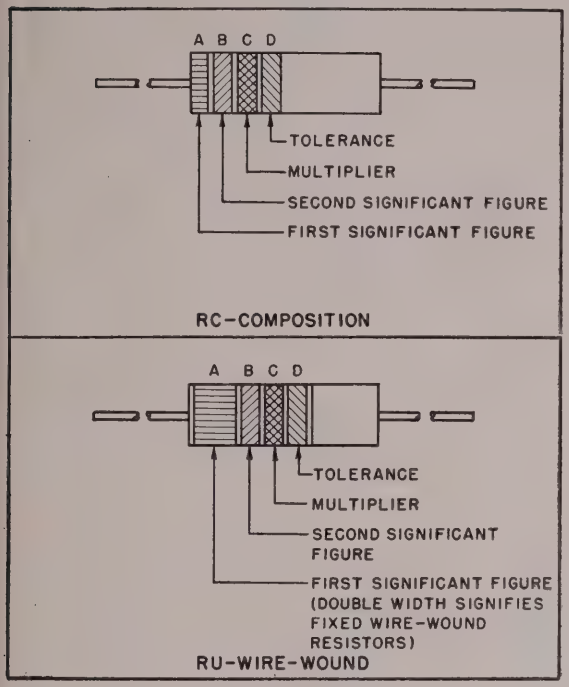
b. Cut. Use axes, handaxes, machetes, and similar tools to cut the headset, meter, RF and power cables. Cut them in a number of places.

c. Burn. Burn as much of the equipment as is flammable; use gasoline, oil, flame throwers, and similar tools. Burn the instruction literature first. Pour gasoline on the cut cables and internal wiring and ignite it. Use a flame thrower to burn spare parts or pour gasoline on the spares and ignite them.

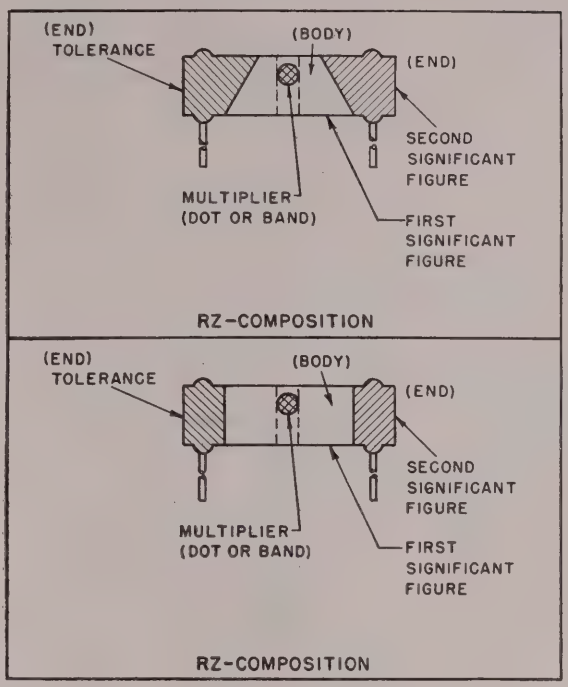
d. Dispose. Bury or scatter destroyed parts or throw them into nearby waterways. This is particularly important if a number of parts have not been completely destroyed.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

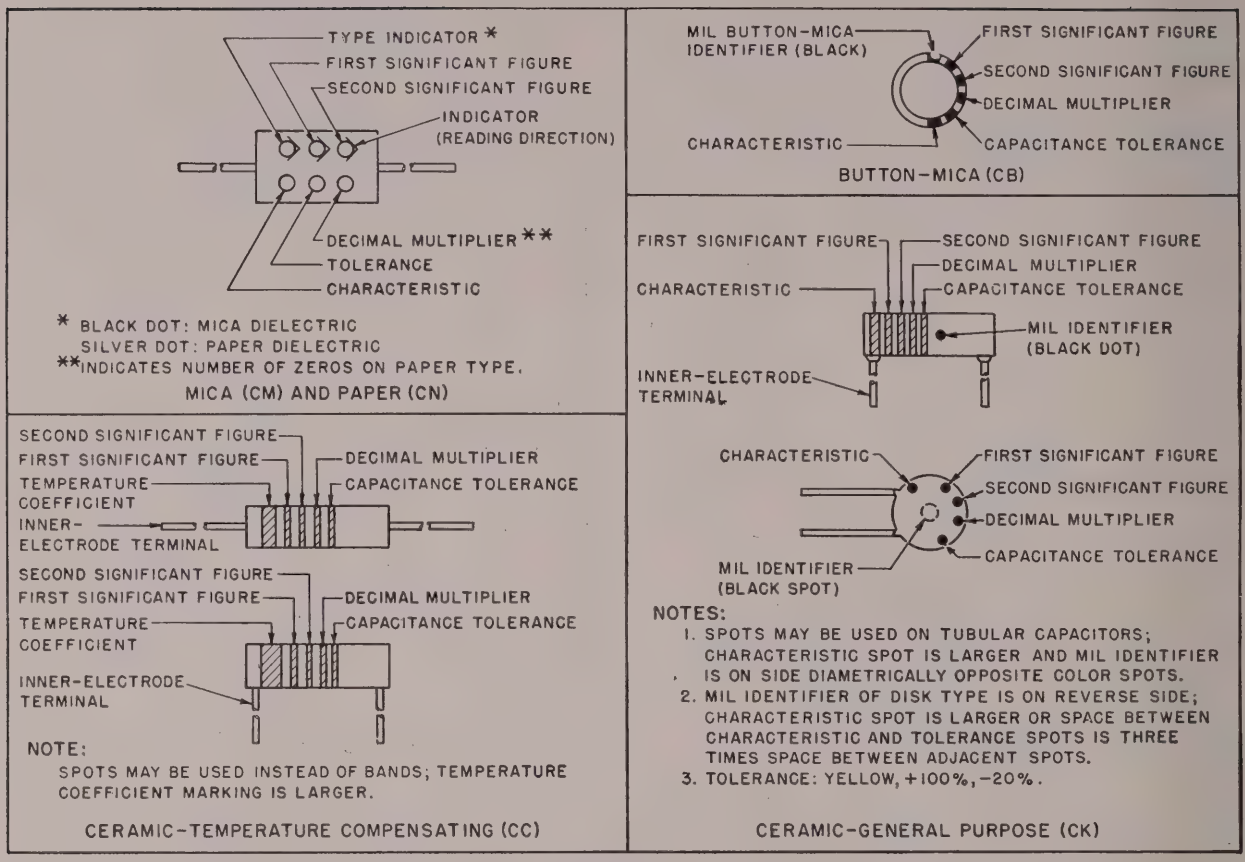
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

Figure 53. MIL-STD resistor color-code markings.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500)[3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 54. MIL-STD capacitor color-code markings.

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By Order of *Wilber M. Brucker,* Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:
HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

ASA (2)
CNGB (1)
Technical Stf, DA (1) except CSigO (30)
Technical Stf Bd (1)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA Air Def Bd (1)
USA Abn & Elct Bd (1)
USA Avn Bd (1)
USA Armor Bd Test Sec (1)
USA Air Def Bd Test Sec (1)
USA Arctic Test Bd (1)
USCONARC (5)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Div (2)
USATC (2)
Ft & Camps (2)
Svc Colleges (5)
Br Svc Sch (5) except USASCS (25)
Gen Depots (2) except Atlanta Gen Depot (None)
Sig Sec, Gen Depots (10)
Sig Depots (17)
Fld Comd, AFSWP (5)
Engr Maint Cen (1)
Army Pictorial Cen (2)
WRAMC (1)
AFIP (1)
AMS (1)
Port of Emb (OS) (2)
Trans Terminal Comd (2)
Army Terminals (2)
OS Sup Agcy (2)
USA Sig Pub Agcy (8)
USA Sig Comm Engr Agcy (1)
USA Comm Agcy (2)
TASSA (13)
Midwestern Rgn Ofc (TASSA) (1)
USA Sig Eqp Spt Agcy (2)
USA White Sands Sig Agcy (13)
Yuma Test Sta (2)
USA Elct PG (1)
Sig Fld Maint Shops (3)
Sig Lab (5)
Mil Dist (1)
USA Corps (Res) (1)
Sectors, USA Corps (Res) (1)
JBUSMC (2)
Units org under fol TOE:
11–7 (2)
11–16 (2)
11–57 (2)
11–127 (2)
11–128 (2)
11–500 (AA–AE) (2)
11–557 (2)
11–587 (2)
11–592 (2)
11–597 (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

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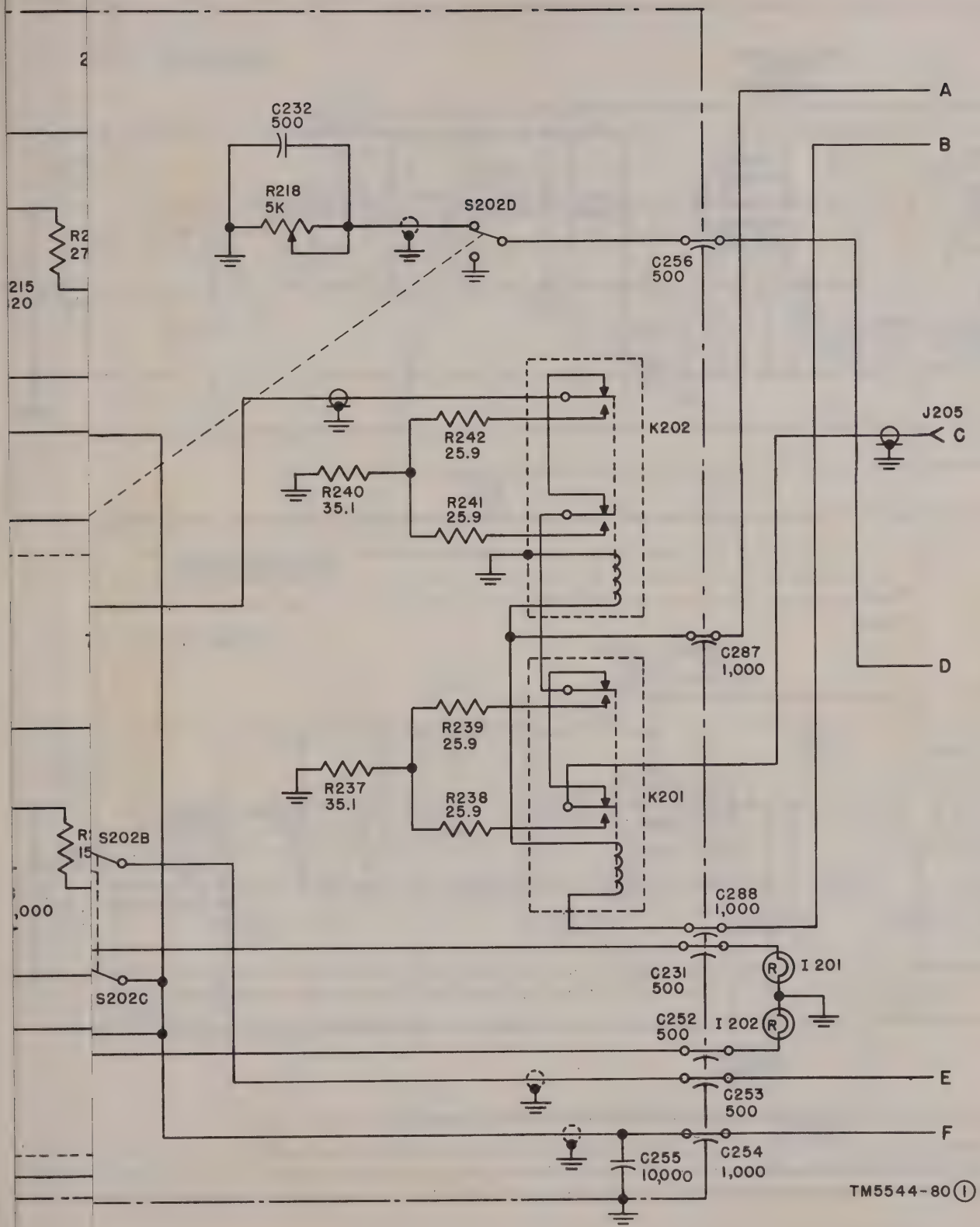
C232
500
R218
5K
S202D
A
B
C256
500
J205
C
K202
R242
25.9
R240
35.1
R241
25.9
C287
1,000
D
R239
25.9
R237
35.1
R238
25.9
K201
S202B
S202C
C288
1,000
C231
500
I 201
C252
500
I 202
E
C253
500
F
C255
10,000
C254
1,000
TM5544-80 (1)

By Order of *Wilber M. Brucker*, Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

ASA (2)
CNGB (1)
Technical Stf, DA (1) except CSigO (30)
Technical Stf Bd (1)
USA Arty Bd (1)
USA Armor Bd (1)
USA Inf Bd (1)
USA Air Def Bd (1)
USA Abn & Elct Bd (1)
USA Avn Bd (1)
USA Armor Bd Test Sec (1)
USA Air Def Bd Test Sec (1)
USA Arctic Test Bd (1)
USCONARC (5)
US ARADCOM (2)
US ARADCOM Rgn (2)
OS Maj Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Div (2)
USATC (2)
Ft & Camps (2)
Svc Colleges (5)
Br Svc Sch (5) except USASCS (25)
Gen Depots (2) except Atlanta Gen Depot (None)
Sig Sec, Gen Depots (10)
Sig Depots (17)
Fld Comd, AFSWP (5)
Engr Maint Cen (1)
Army Pictorial Cen (2)
WRAMC (1)
AFIP (1)
AMS (1)
Port of Emb (OS) (2)
Trans Terminal Comd (2)
Army Terminals (2)
OS Sup Agcy (2)
USA Sig Pub Agcy (8)
USA Sig Comm Engr Agcy (1)
USA Comm Agcy (2)
TASSA (13)
Midwestern Rgn Ofc (TASSA) (1)
USA Sig Eqp Spt Agcy (2)
USA White Sands Sig Agcy (13)
Yuma Test Sta (2)
USA Elct PG (1)
Sig Fld Maint Shops (3)
Sig Lab (5)
Mil Dist (1)
USA Corps (Res) (1)
Sectors, USA Corps (Res) (1)
JBUSMC (2)
Units org under fol TOE:
11–7 (2)
11–16 (2)
11–57 (2)
11–127 (2)
11–128 (2)
11–500 (AA–AE) (2)
11–557 (2)
11–587 (2)
11–592 (2)
11–597 (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

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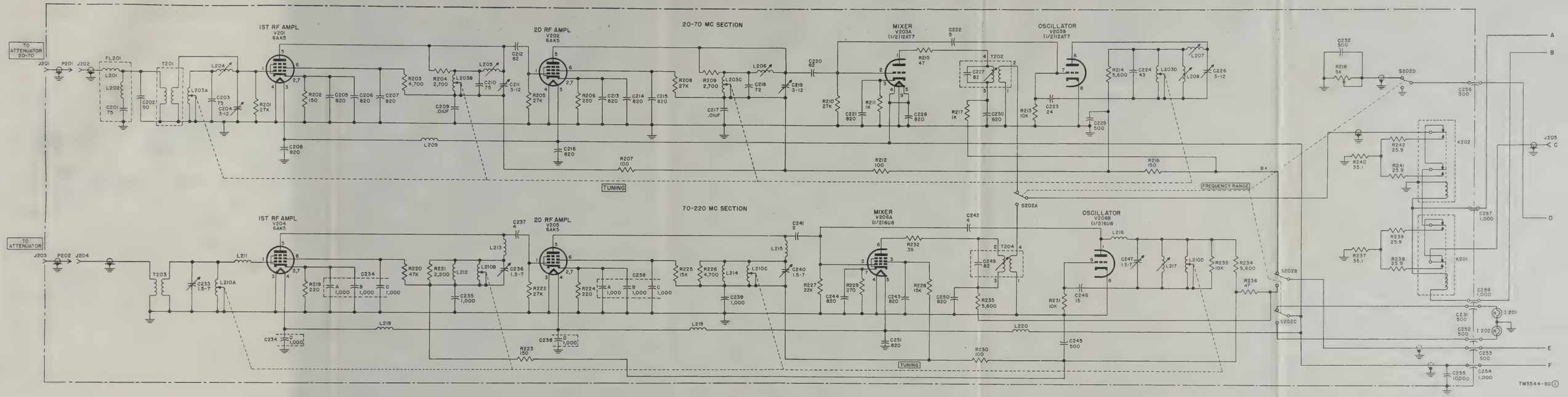

Figure 55. Lf tuner, schematic diagram.

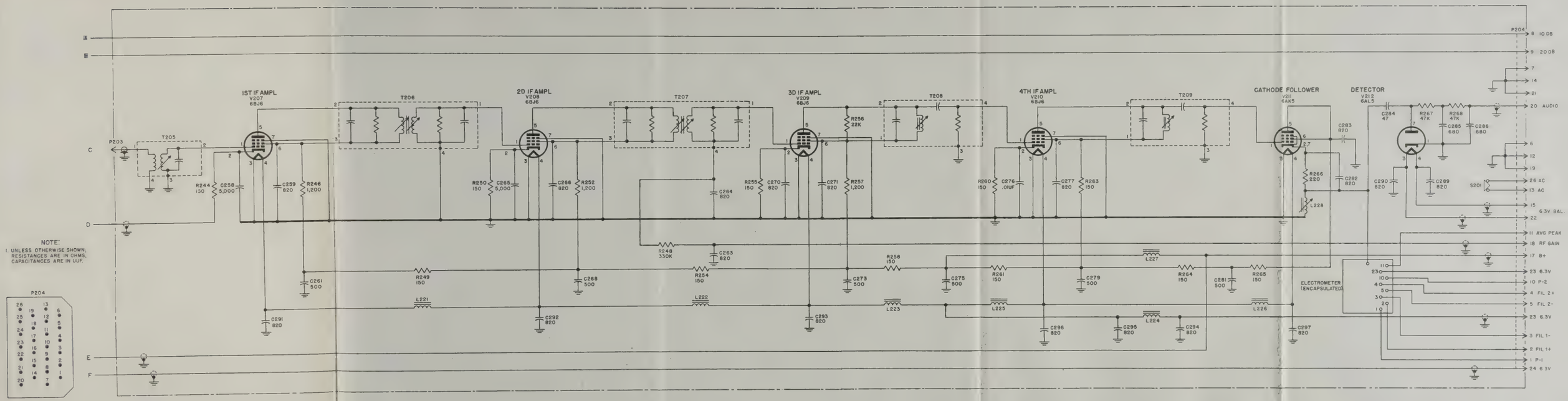

Figure 55—Continued.

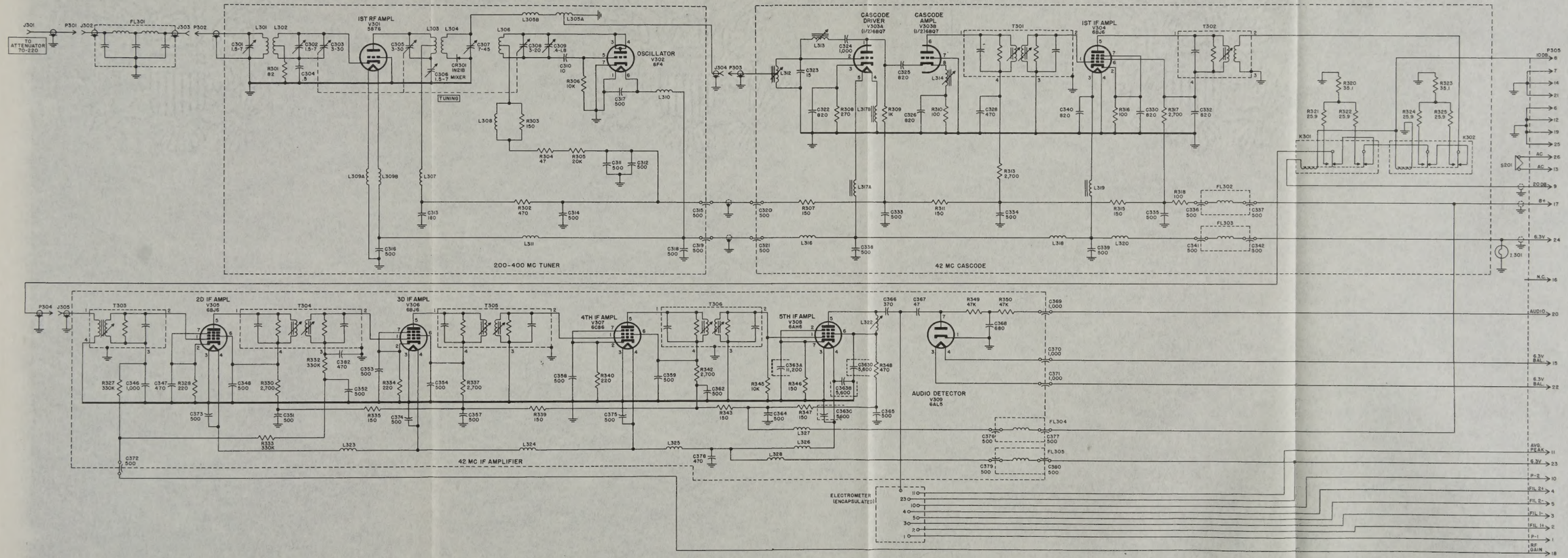

Figure 56. Hf tuner, schematic diagram.

TM 5544-81

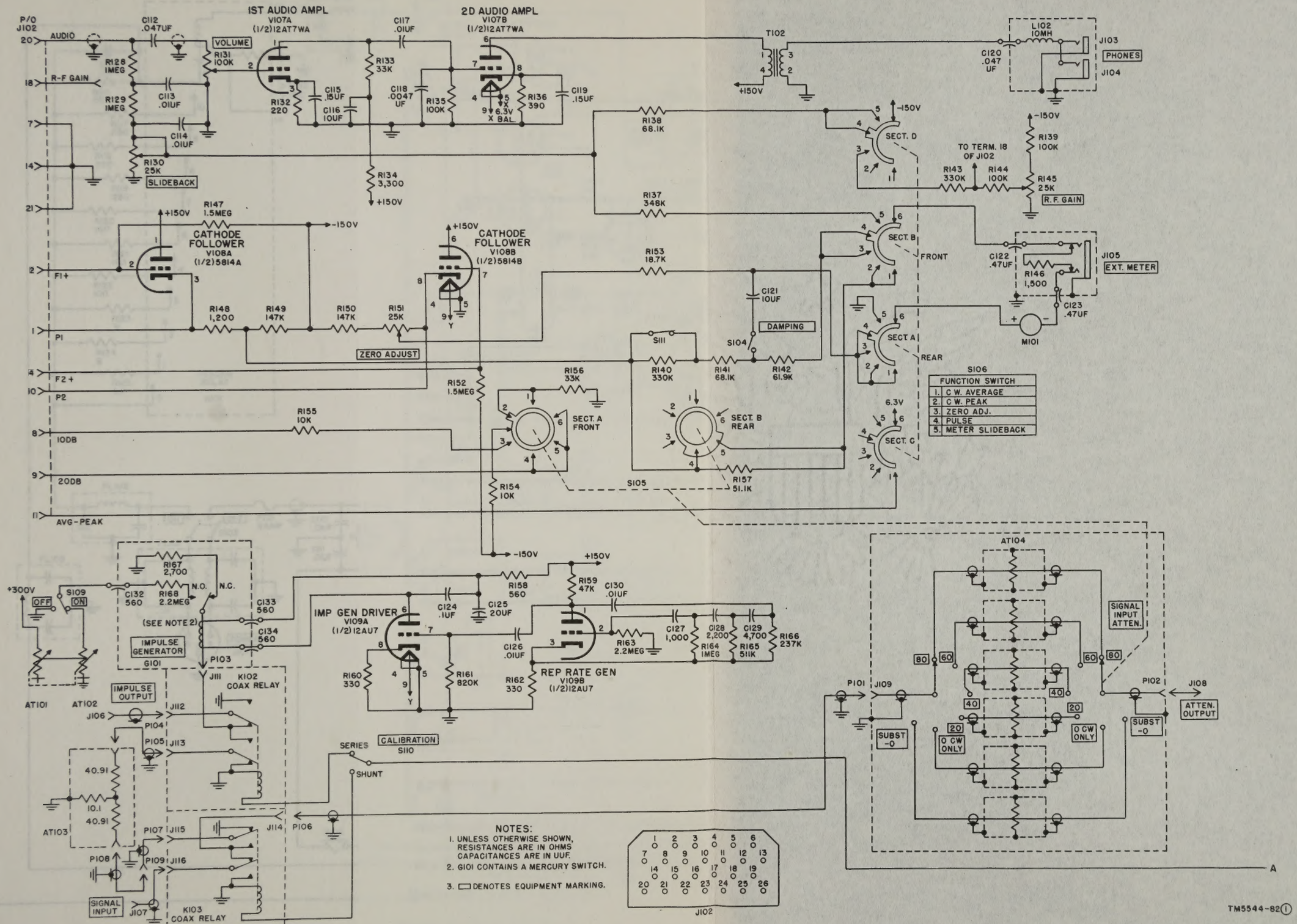

Figure 57. Main unit, schematic diagram.

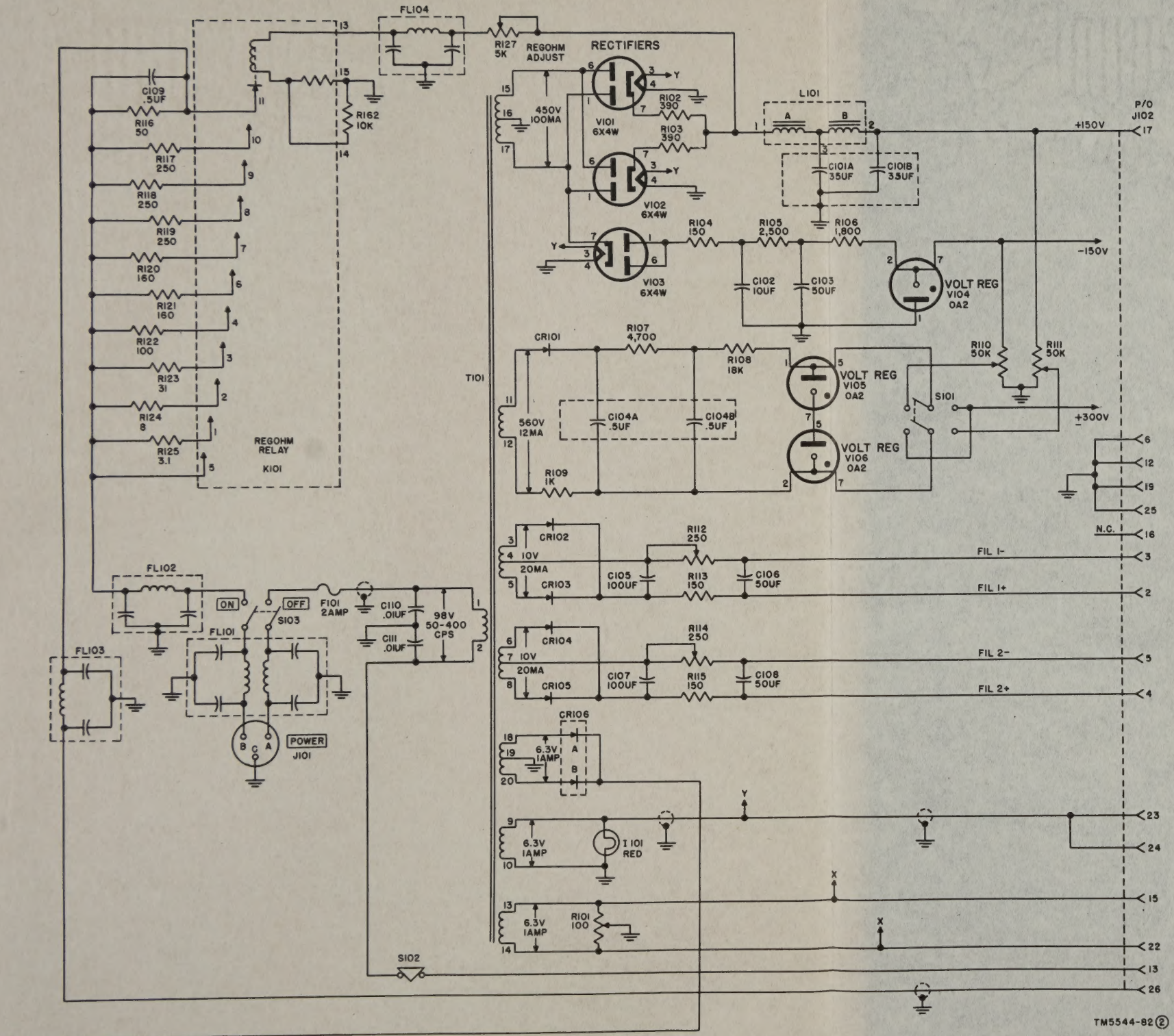

Figure 57—Continued.